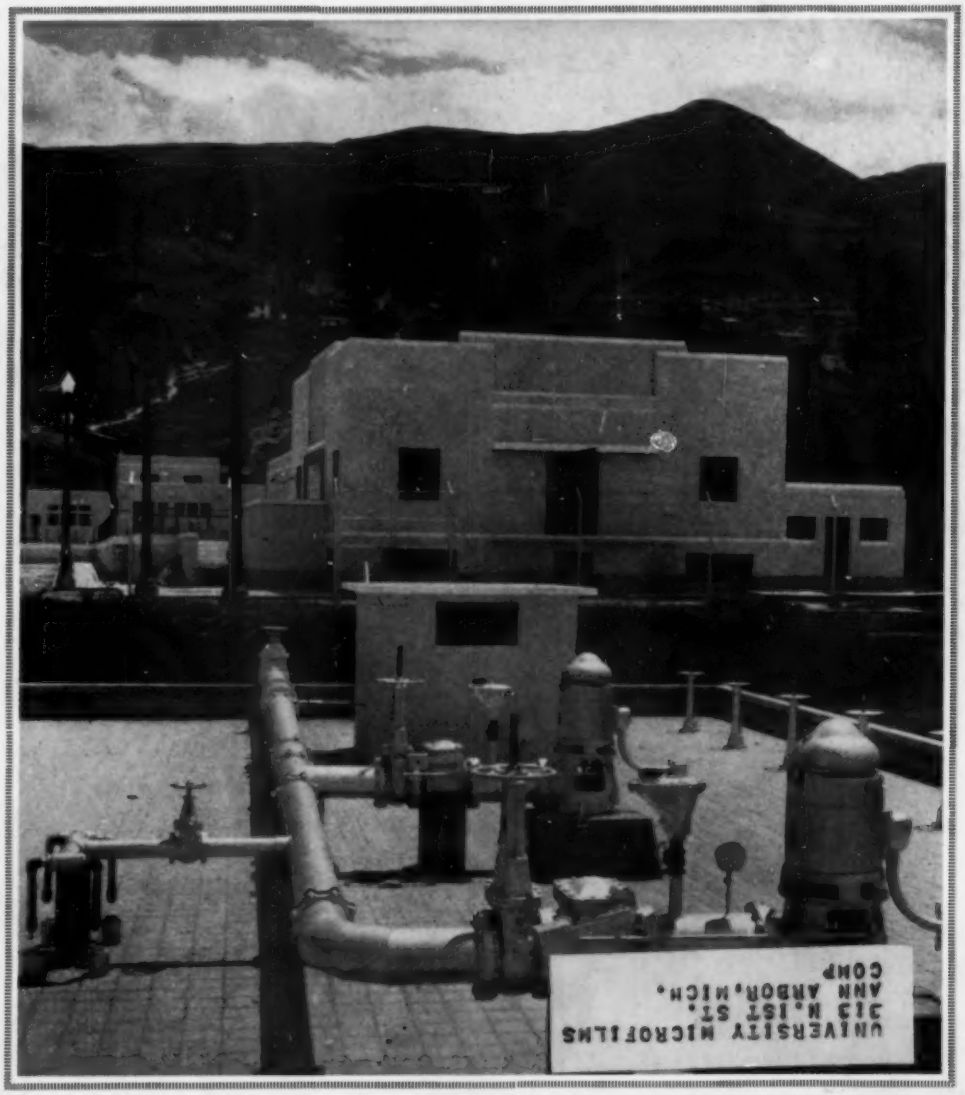
# WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

*A Scranton Gillette Publication*

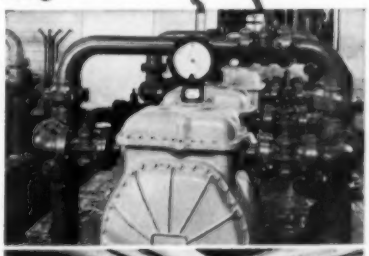

UNIVERSITY MICROFILMS
313 N. 1ST ST.
ANN ARBOR, MICH.
COHP

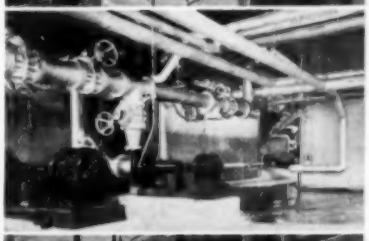
DECEMBER 1956

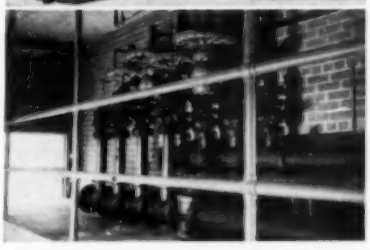
*A 415 Year Old City Gets a New Water Plant*
(Pages 529-533)

*A Sewage Force Main Improves With Age*
(Pages 564-568)

# acf LUBRICATED PLUG VALVES







acf Lubricated Plug Valves are extensively used in sewage disposal plants throughout the United States because they offer so many operating advantages not found in other plug valves. The full pipe area conduit in both the rectangular and round port valves assures smooth, unobstructed flow of the most viscous ladings . . . reduces turbulence and head loss to a minimum. The quick, quarter-turn from full-open to full-closed provides split-second control even at capacity flow. The lubricated cylindrical plug never allows solids to wedge against the turning surfaces since it never lifts from its seat . . . the precision machined plug shears tough, stringy obstructions as clean as a knife.

TEFLON* head gaskets, which provide easy operation and assure a tight seal, are standard on acf Lubricated Plug Valves. Write today for further information about these superior valves.

## W-K-M

DIVISION OF acf INDUSTRIES INCORPORATED

PLANT: MISSOURI CITY, TEXAS • MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS

5621

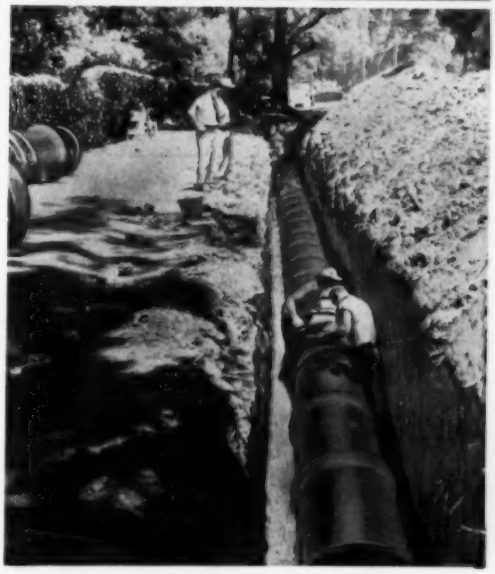
MANUFACTURERS OF

W-K-M THROUGH-CONDUIT GATE VALVES

acf LUBRICATED PLUG VALVES

KEY RETURN BENDS AND FITTINGS

# TAX-CONSCIOUS COMMUNITIES Specify CLAY PIPE for Economy



**MENLO PARK SANITARY DISTRICT** recently added more than 24,000 feet of Vitrified Clay Pipe sewers to serve the rapidly growing residential areas of San Mateo County, California. Since its founding, the District has installed approximately 150 miles of sewers.

District officials have been able to reduce tax rates consistently for the past several years, in spite of the national trend toward tax increases. Efficient operation is the key to this economy, and never-wear-out Clay Pipe plays an important part in keeping maintenance costs down. As District Superintendent Cedric Webster puts it: *"Since the sewers are of Clay Pipe, we do not believe that they will ever need to be replaced."*

**DISTRICT OFFICIALS:** Lawrence H. Cook, *Secretary of Board of Trustees and Acting District Engineer*
Cedric Webster, *Superintendent*
Frank Sasagawa, *Inspector*

**CONTRACTOR:** Pat Barkley Co.
John Coelho, *Foreman*

*Vitrified* CLAY PIPE

CLAY PIPE NEVER WEARS OUT!

**NATIONAL CLAY PIPE MANUFACTURERS, INC.**
1820 N. Street, N.W., Washington 6, D. C.

206 Connally Bldg., Atlanta 3, Ga.
100 N. LaSalle St., Rm. 2100, Chicago 2, Ill.
703 Ninth & Hill Bldg., Los Angeles 15, Calif.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio

C-856-4

**Progress in Public Health - Through Clay Pipe Research**

# Tough Problem Solved

## F&P Engineering solves Meyersville's problem: Higher fire insurance rates or safe water.

If all the property owners in Meyersville, Maryland were to avoid an increase in fire insurance rates, the main water pressure, during fire emergency, had to be maintained above the allowable minimum.

All other automatic proportioning Chlorinator systems recommended to Meyersville required permanent head losses far in excess of the allowable minimum or were prohibitively expensive.

All, that is, except the F&P Chlorinator. F&P, applying its wide instrumentation and systems engineering experience, utilized standard components to solve Meyersville's problem.

Since its installation the F&P unit has given accurate, maintenance-free, money-saving service.

If you have *any kind* of chlorination problem, why don't you call Fischer & Porter now? Write or call today—without obligation—for complete information and engineering data.

FP **FISCHER & PORTER**

226 FISCHER ROAD, HATBORO, PA.

IN CANADA:
FISCHER & PORTER (CANADA) LTD.
TORONTO 18, ONTARIO

LA1113

# WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL


## COMING ARTICLES

Developments and Trends in Water Supply—1956 ..... *Merryfield*
Developments and Trends in Sewage Disposal—1956 ..... *Jensen*
"Where Water Goes Atlanta Grows!"—a Major Extension Program *Weir*
The "Biosorption" Sewage Treatment Process at Austin, Texas ... *Ullrich*
Operation and Maintenance of Distribution Systems ..... *Miller*
A Filtration Plant With Novel Design Features ..... *Hartung*
How Los Angeles Protects Its Sewers Against Gas Attack ..... *Pardee*
Notes on the Continuous Production of Activated Silica ..... *Langworthy*
Sewage Treatment Facilities of Port Clinton, Ohio ..... *Hauenstein*
Notes on Water Works Law (A continuing series) ..... *Murdoch*
Sewage Works Practices (Two series) ..... *Bloodgood & Jaffee*


E. SCRANTON GILLETTE
Publisher

•

LINN HARRISON ENSLOW
Editor

•

GEORGE E. SYMONS, Ph.D.
Feature Writer

Assistant Editor, F. C. MAURER
Make-Up Editor, R. J. ROONEY

•

Editorial Associates

A. M. RAWN J. R. BAYLIS C. E. KEEFER
L. L. HEDGEPETH H. P. ORLAND

•

EXECUTIVE OFFICE

185 North Wabash Ave., Chicago 1, Ill.
E. S. Gillette, President & Publisher
C. T. Gillette, Secy.
H. J. Conway, Treas.

EDITORIAL OFFICES

155 East 44th Street, New York 17, N. Y.
Linn. H. Enslow, Vice-pres. & Editor
F. C. Maurer, Assistant Editor

BUSINESS OFFICES

Chicago: 185 North Wabash Ave.
H. J. Conway, Adv. Editor
Terence McCoy, Western Sales Mgr.

New York: 155 East 44th St.
Evans J. Kall, Eastern Sales Mgr.
Wm. R. Joyce, Midwestern Sales Mgr.

South: 1212 41st Street
Belview Heights
Birmingham 8, Ala.
Fred W. Smith, Rep.

West Coast: 1709 W. 8 St., Los Angeles
Don Harway & Co., Rep.



*Copyright 1956*
*By Scranton Publishing Co., Inc.*



**Vol. 103** **DECEMBER 1956** **No. 12**



The New El Placer Water Purification Plant ..... 529
by George C. Bunker, Dr. Eng.

Long Range Planning for Water Service ..... 534
by Abel Wolman, Dr. Eng.

Properties of Water — I ..... 537
by George E. Symons, Ph. D.

How to Reduce Operating Costs at Water Treatment Plants — I ..... 542
by A. A. Hirsch

How to Reduce Operating Costs at Water Treatment Plants — II ..... 546
by J. L. Love

Illinois Cities Build to Meet Increased Water Demands ..... 549
by John R. Towers

Lime and Lime Slaking ..... 554
by H. E. Lordley

Los Angeles Host to Federation's 29th Annual Meeting ..... 558

A Sewage Force Main Improves with Age ..... 564
by C. E. Keefer

Raw Sewage Lagoons ..... 566
by Glen J. Hopkins and Joe K. Neel

The Annual Conference of the Institute of Sewage Purification ..... 571
by John Finch

Meetings Scheduled ..... 82A

New Equipment ..... 92A

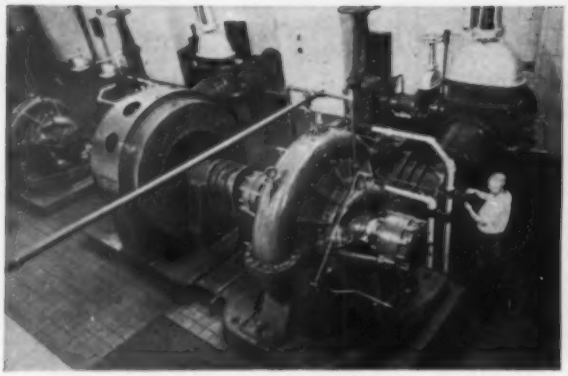
Manufacturers' News ..... 100A

Literature and Catalogs ..... 106A



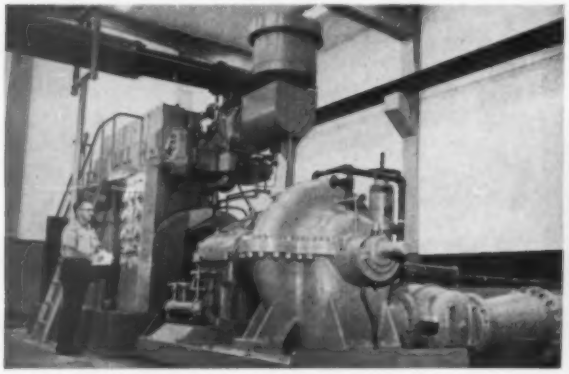
WATER AND SEWAGE WORKS is published monthly with an extra issue in June. Subscriptions including the Reference and Data issue in the U.S. and Canada, 1 year $3.00; 2 years $4.50; 3 years $6.00. Other countries $1.50 per year additional. Single copies 25c except Reference and Data issue 50c.

WATER AND SEWAGE WORKS, Reg. U.S. Patent Off. Published monthly by Scranton Publishing Co., at 1600 N. Main St., Pontiac, Ill. Entered as second class matter at the post office at Pontiac, Ill., under Act of March 3, 1879.

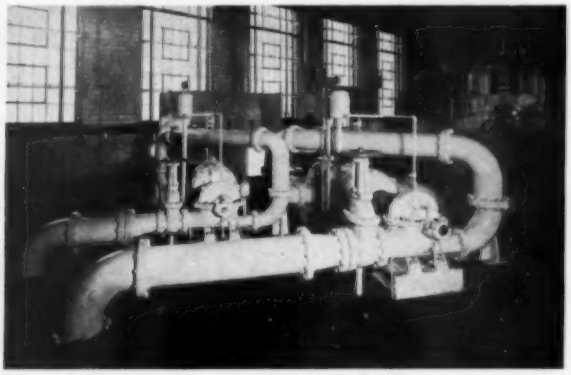


**PHILADELPHIA, PA.** One of ten Worthington high lift centrifugal pumps at the Torresdale Pumping Station. Capacity of this pump is 40 MGD.

**NIAGARA FALLS, N. Y.** Worthington high lift pumps in the Water Filtration Plant. In all, there are ten Worthington pumps, 15 to 30 MGD each.



**MIAMI, FLA.** One of four Worthington 15 MGD pumps driven by a Worthington diesel engine at the new Alexander Orr, Jr., Water Treatment Plant.



**SHARON, PA.** Two Worthington two-stage centrifugal pumps at the Sharon Valley Water Company. Capacity of the units is 2 MGD and 4 MGD each.

# Reliability proved a thousand times a day

## You benefit 3 ways when you deal with Worthington—world's leading builder of water works equipment

**High output and low costs.** Literally thousands of municipalities from the smallest to the largest have found that they get high volume output and low operating costs when they install water works equipment by Worthington. Every day, the reliability of this equipment is thoroughly proved in installations like those pictured here.

**An unbiased recommendation.** Because Worthington makes all types of pumps and drives, you get the advantage of an equipment recommendation based on a broad look at all available ways of doing the job. Trained specialists will help you analyze your requirements and select the proper equipment.

**Unit responsibility.** You do business with one company—eliminating delays and inconvenience that can occur when you are forced to co-ordinate the efforts of several suppliers. Unit responsibility by Worthington saves you time and money.

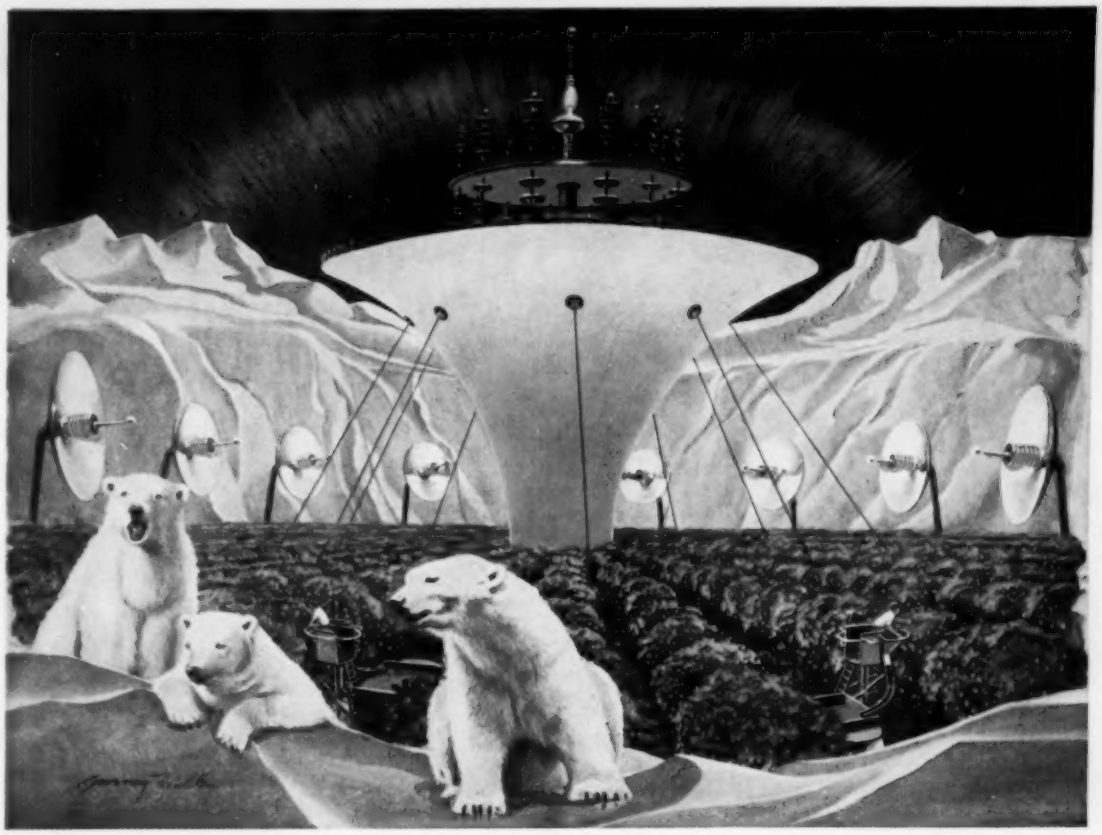
Some of the water works equipment built by Worthington include: horizontal and vertical centrifugal pumps; vertical turbine pumps; diesel, gas and dual fuel engines; steam turbines; speed increasing gears; and water meters.

For more information on any of these products, call your nearest Worthington District Office, or write Section W66, Worthington Corporation, Public Works Department, Harrison, N. J. In Canada: Worthington (Canada) 1955, Ltd., Toronto, Ont.

W.6.6

**WORTHINGTON**

**ALL MAJOR PUBLIC WORKS EQUIPMENT UNDER ONE RESPONSIBILITY**



Huge solar engines imprisoning the heat of the sun may create islands of fertility in icy wastelands, thus vastly increasing the productive food areas of the earth.

***100 years from now...***

# WE MAY GROW ORANGES AT THE POLES!

What will the world be like generations from now? Wonderful new products and methods will make living easier, pleasanter, safer. But in this marvelous new era, one old friend will still serve efficiently. Water and gas will be carried by rugged cast iron pipe laid today. For more than seventy American water and gas utilities, cast iron mains over a century old are still serving dependably. And modern cast iron pipe ...centrifugally cast and quality controlled...is far tougher and more durable.

U.S. Pipe is proud to be one of the leaders in a forward-looking industry whose service to the world is measured in centuries.

**U.S. cast iron PIPE**

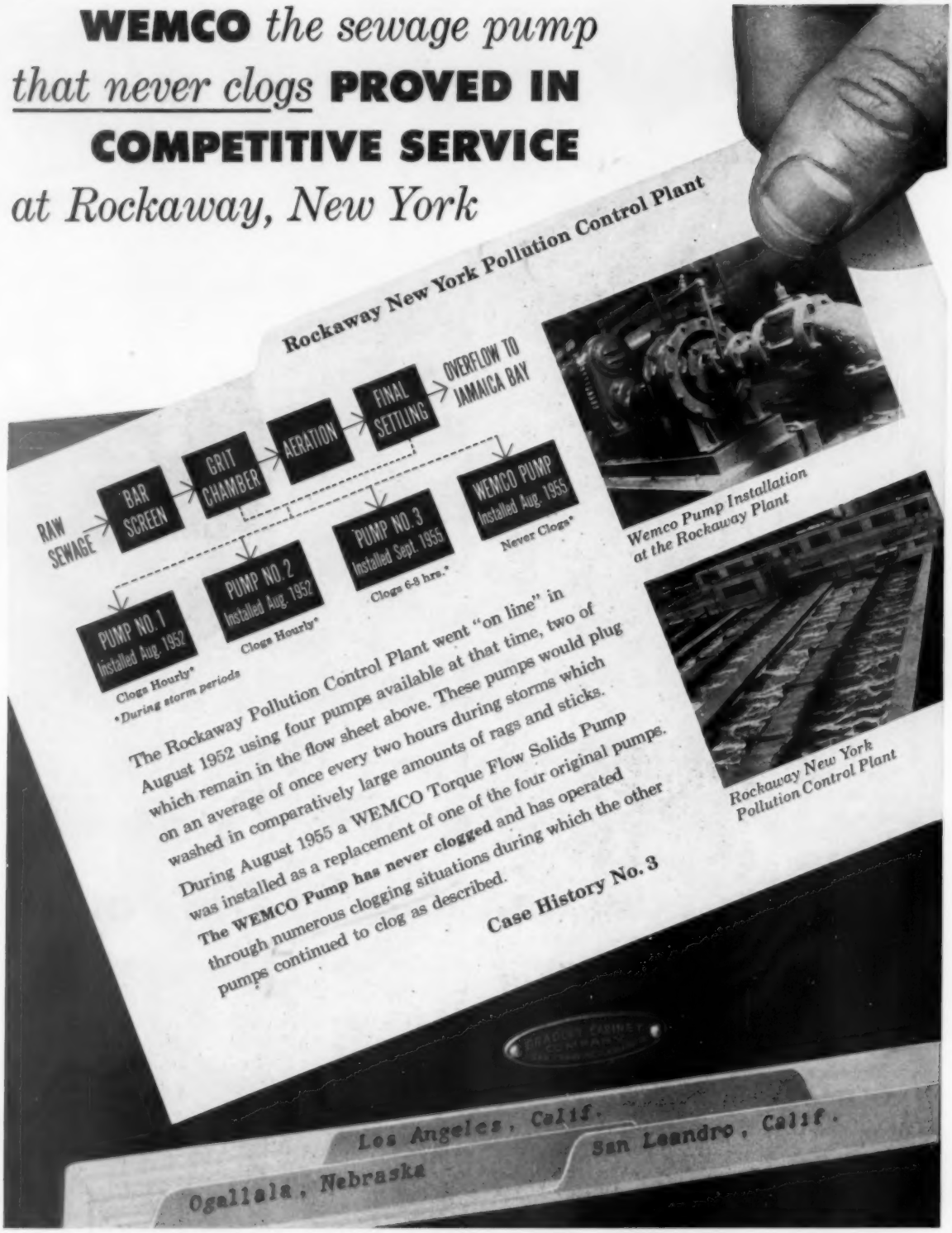
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE

CAST IRON

**U. S. PIPE AND FOUNDRY COMPANY, General Office: Birmingham 2, Alabama**

**A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE.**

# **WEMCO** *the sewage pump that never clogs* **PROVED IN COMPETITIVE SERVICE** *at Rockaway, New York*

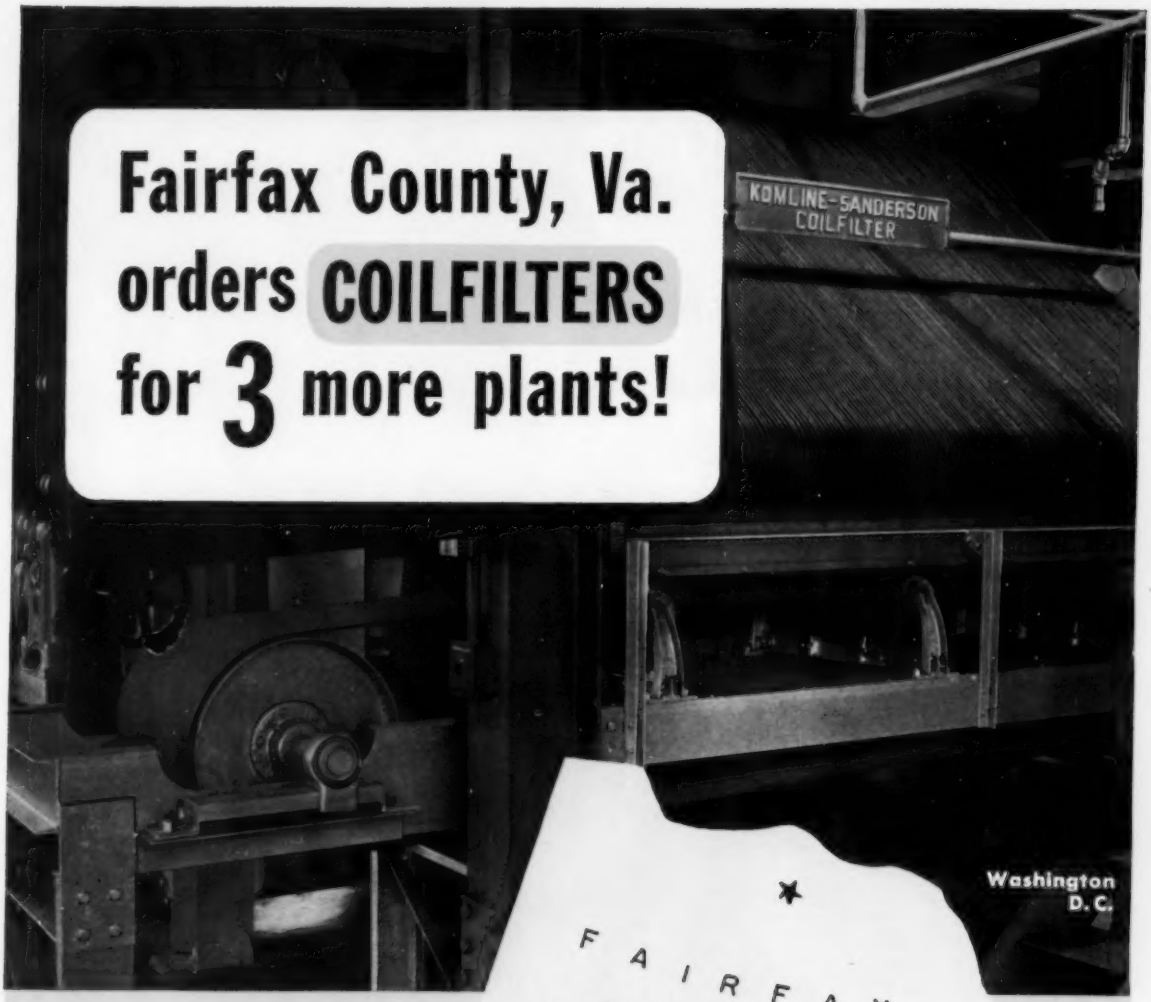

Rockaway New York Pollution Control Plant
RAW SEWAGE
BAR SCREEN
GRIT CHAMBER
AERATION
FINAL SETTLING
OVERFLOW TO JAMAICA BAY
PUMP NO. 1 Installed Aug. 1952
Clogs Hourly*
PUMP NO. 2 Installed Aug. 1952
Clogs Hourly*
PUMP NO. 3 Installed Sept. 1955
Clogs 6-8 hrs.*
WEMCO PUMP Installed Aug. 1955
Never Clogs*
*During storm periods
Wemco Pump Installation at the Rockaway Plant
Rockaway New York Pollution Control Plant
The Rockaway Pollution Control Plant went "on line" in August 1952 using four pumps available at that time, two of which remain in the flow sheet above. These pumps would plug on an average of once every two hours during storms which washed in comparatively large amounts of rags and sticks. During August 1955 a WEMCO Torque Flow Solids Pump was installed as a replacement of one of the four original pumps. **The WEMCO Pump has never clogged** and has operated through numerous clogging situations during which the other pumps continued to clog as described.
**Case History No. 3**
Los Angeles, Calif.
San Leandro, Calif.
Ogallala, Nebraska

**Wemco's unique torque-flow design has been responsible for many outstanding "never clog" records. The principle is fully explained in available literature. It will save you thousands of dollars in operating costs. Write today for your copy.**

**WEMCO**
WESTERN MACHINERY COMPANY

650-L Folsom St. • San Francisco 7, Calif. • Representatives in principal cities of the United States and Canada and in major countries throughout the world

# Fairfax County, Va. orders COILFILTERS for 3 more plants!



Continued confidence is the finest proof of product performance. In 1954 the Westgate sewage treatment plant in Fairfax County, Virginia, designed by Massey Engineers, placed their two 200 sq. ft. Coilfilters in operation. When equipment was purchased for three more Fairfax County plants in 1956, it was only natural that Coilfilters should be included.

The Little Hunting Creek and Dogue Creek plants, designed by R. Stuart Royer and Associates, will each contain an 85 sq. ft. "package" unit. The Upper Pimmit Run plant, designed by Massey Engineers, will include a 150 sq. ft. Coilfilter and auxiliaries.

Alexander Potter Associates are Consultants to the County of Fairfax.

## KOMLINE-SANDERSON ENGINEERING CORPORATION

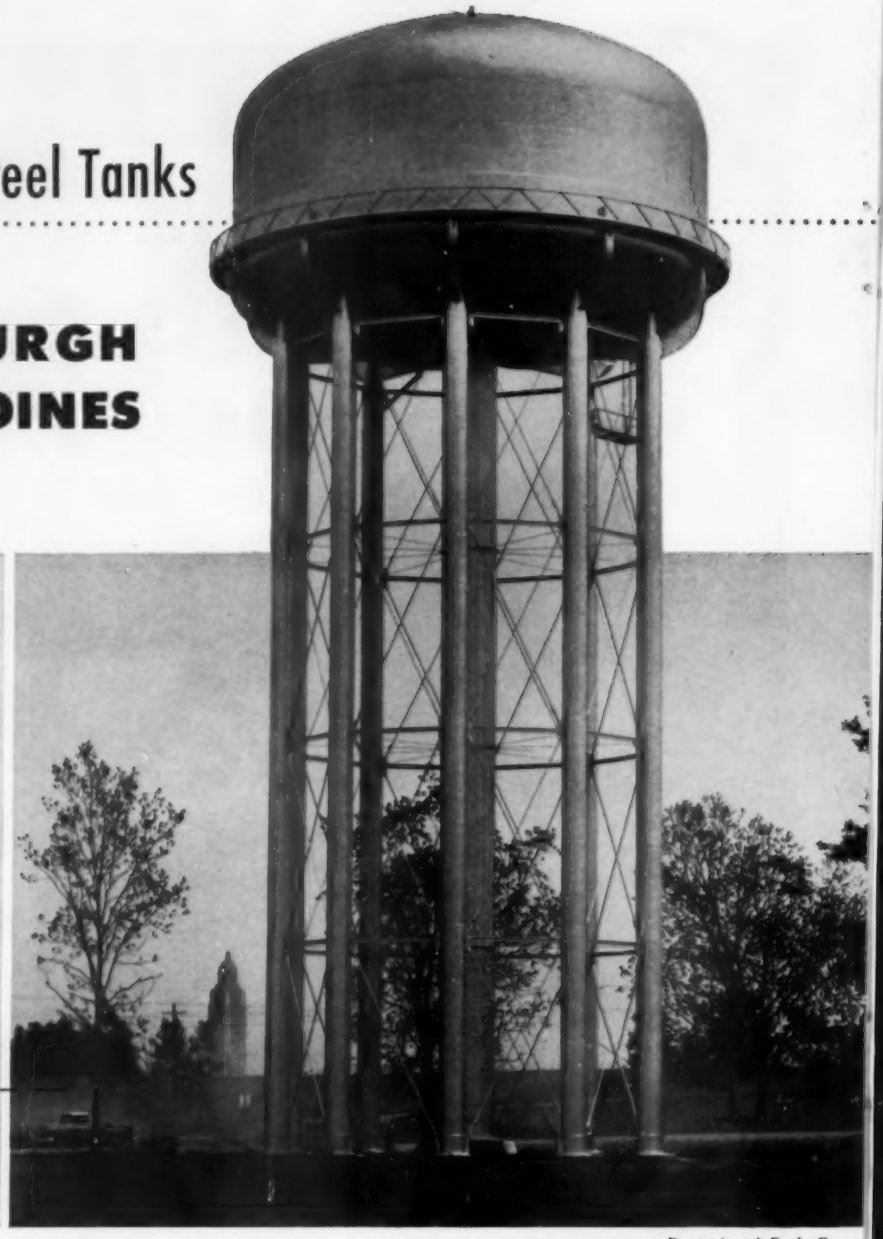
**Peapack, New Jersey**

***Manufacturers of the* COILFILTER *... the modern sludge vacuum filter***

# Elevated Steel Tanks

by

## PITTSBURGH • DES MOINES



*Symbols of service in Louisiana*

*Barnard and Burk, Consulting Engineers to Greater Baton Rouge Port Comm.*

Symbols of service to the people . . . in the left distance, the tower of Louisiana's beautiful State Capitol at Baton Rouge, and in foreground, the handsome PDM Steel Elevated Tank just completed for the Greater Baton Rouge Port Commission. • Dependable water service at uniform pressures round the clock is assured by the million-gallon capacity of the Radial Cone tank, elevated on a tower 125 ft to bottom. The tank diameter is 71 ft, with 35 ft headrange.
Let us send you our latest Modern Water Storage Catalog.

**PITTSBURGH • DES MOINES STEEL CO.**

**Plants at PITTSBURGH, DES MOINES, SANTA CLARA, FRESNO, and CADIZ, SPAIN**

*Sales offices at:*

PITTSBURGH (25)....3418 Neville Island
NEWARK (2)..218 Industrial Office Bldg.
CHICAGO (3) 1222 First National Bank Bldg.
LOS ANGELES (48)...6399 Wilshire Blvd.
DES MOINES (8).....919 Tuttle Street
DALLAS (1).....1223 Praetorian Building
SEATTLE.....526 Lane Street
SANTA CLARA, Cal.....649 Alviso Road
MADRID, SPAIN .....Diago DeLeon, 60

PDM ELEVATED STEEL TANKS

# Let us remember the mountains of Attica and not abandon our land

*"There are mountains in Attica which can now keep nothing . . . but which were clothed, not so very long ago, with fine trees producing timber . . . while the country produced boundless pasture for cattle . . ."*

As early as 300 B.C., when Plato thus lamented a tragedy of exhausted natural resources, there was little left of Attica's fertility — only insects crawling about the *"sites of extinct water supplies."* A lesson 2000 years old, to be heeded if we would escape the fate of Attica.

And the first logical step in vital water conservation is to replace flat, waste-conducive rates with Badger Metering.

The demand for water is at its peak in our history. All classes of users compete for more and *more.* A 75% increase in consumption is expected by 1975. In some areas the situation is already critical.

Curtailing waste with Badger Meters — fairly apportioning the responsibility and accounting for water use — is not only a sound investment in your community's future, but essential to its very survival.

*The time to act is now — while there's still some water left to save!* Write today for information on Badger Meters, or to arrange for a representative to call.

# Badger Water Meters

*Badger Meters have conserved it for 50 years*

**BADGER METER MFG. CO.** MILWAUKEE 43, WISCONSIN

Chicago South District Filtration Plant

# Years and Years Ahead in PNEUMATIC Instruments and Controls For Water Works Service

Because this equipment is specially designed for water works service, the Builders Pneumatic System is outstandingly successful in operation. Builders Pneumatic Instruments and Controls are now giving top performance on many important installations across the country, including Chicago's South District Filtration Plant, the world's first and largest pneumatically equipped plant, built in 1946.

Builders Pneumatic Meters and Controls are right for water works service in every detail — in accuracy, in range, and in materials of construction. Each system profits by our broad design and manufacturing experience . . . a "plus" service we extend to engineers to help in obtaining the correct instruments and controls for each project. Builders-Providence equipment is backed by our own nationwide organization of service specialists . . . another assurance of economical plant operation.

For a first-hand look at the advantages of Builders Pneumatic Instruments and Controls, visit one of the many installations now in service. We will be glad to help arrange such a visit for you. Write Builders-Providence, Inc., 350 Harris Ave., Providence 1, Rhode Island.

B-I-F

## B-I-F INDUSTRIES

PROVIDENCE, RHODE ISLAND

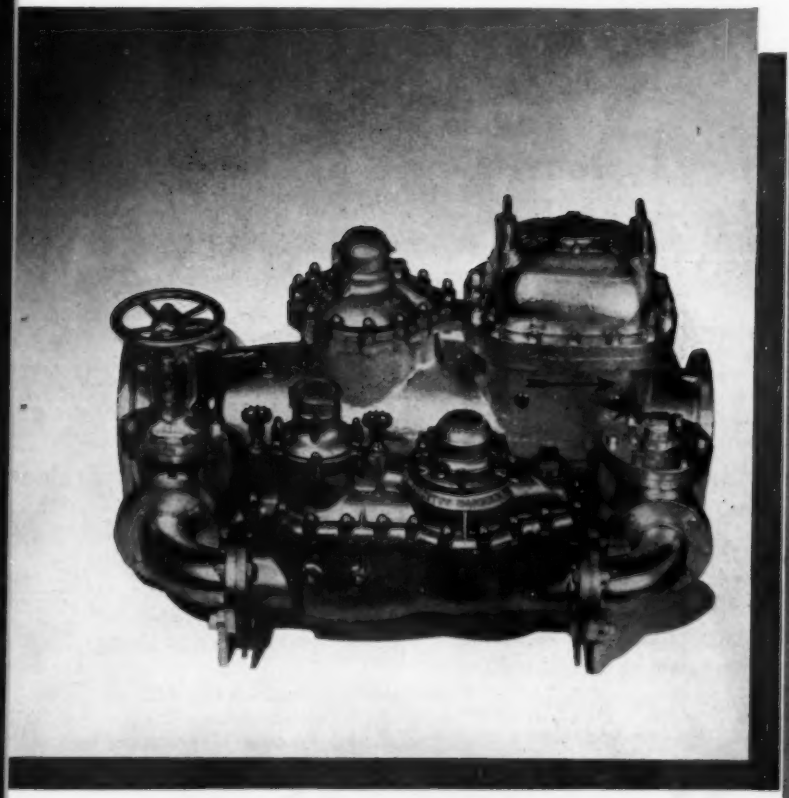
BIF METERS FEEDERS CONTROLS

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO. • BUILDERS-PROVIDENCE, INC.

# Are you getting accurate records of the amount of water used through your combination Industrial and Fire Service Lines?

## You will, if you have Hersey Detector (Fire Service) Meters on those lines.

## Really worth investigating.



**THIS HERSEY DETECTOR FIRE SERVICE METER**

**equipped with a Bronze Case Compound Meter on its by-pass, is a further refinement of this meter.**

**It meets the demand for accurately measuring rates of flow from small domestic services through ranges required for industrial purposes and for fire service lines, all without obstruction to the flow.**

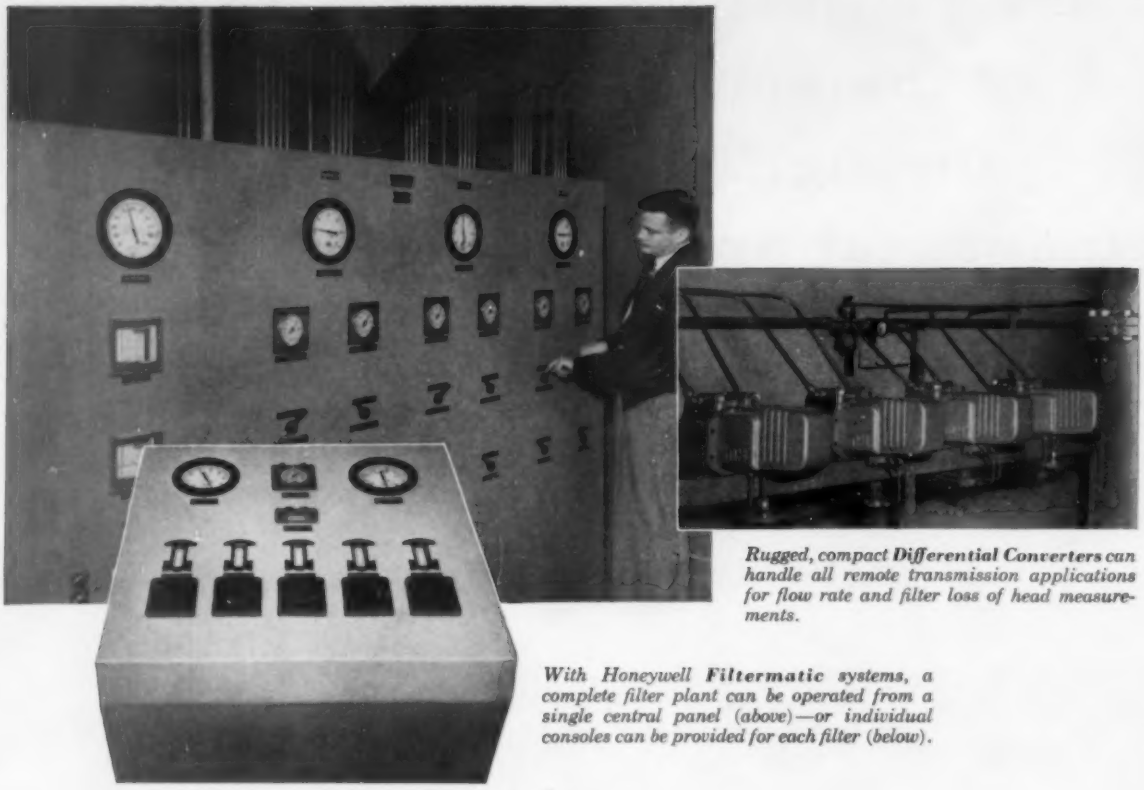
**This combination also successfully meets the requirements of a large number of water works furnishing water through a master meter to consumers not under their immediate jurisdiction.**

*Listed as standard under the re-examination service of Underwriters' Laboratories, Inc. and approved by Factory Mutual Laboratories for use in Factory Mutual insured properties. Also listed by Underwriters' Laboratories of Canada*

**HERSEY MANUFACTURING COMPANY**

**SOUTH BOSTON, MASS.**

**BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA ATLANTA — DALLAS — CHICAGO — SAN FRANCISCO — LOS ANGELES**



*Rugged, compact* ***Differential Converters*** *can handle all remote transmission applications for flow rate and filter loss of head measurements.*

*With Honeywell* ***Filtermatic*** *systems, a complete filter plant can be operated from a single central panel (above)—or individual consoles can be provided for each filter (below).*

# Honeywell *Filtermatic** Systems give you *centralized automatic* control of your filtration plant

YOU CAN put a new kind of operating economy and simplicity into your water filtration plant, with Honeywell *Filtermatic* systems. These modern filter control systems give you a unique combination of design, operating and maintenance features.

**Flexible control.** Filtration and backwashing can be regulated by any of a variety of methods, at the operator's discretion. He can choose manual, semi-automatic, or remote manual operation. Or he can have automatic control established by pre-set flow rates, clearwell level or water usage.

**Flexible design.** Free from limitations of cables and mechanical linkages, *Filtermatic* systems are easily designed into central control panels in laboratory or office. Or, individual operating consoles can be provided on the filter floor.

**Simple installation.** Components are compact . . . require less space in pipe gallery or on the operating floor. First cost is low, installation is easy on either new or existing filters.

**Simple maintenance.** Built of rugged elements, *Filtermatic* systems function continuously with minimum attention. Use of interchangeable units—the same *Differential Converter* transmitters, for instance, for level, flow rate, differential pressure—reduces spare parts requirements. The system uses clean, dry air, so pipe galleries stay clean and corrosion problems are reduced.

Ask your local Honeywell sales engineer to discuss your specific filter requirements . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

MINNEAPOLIS
**Honeywell**
BROWN INSTRUMENTS
*First in Controls*

* Tradename of Minneapolis-Honeywell Regulator Co.

# any thread you need!

## MUELLER CORPORATION STOPS

A combination of practically any type inlet or outlet thread on Mueller Corporation Stops permits you to connect to any type main and run the service line best suited to your needs. You may have a requirement for connecting to thin walled pipe. For this purpose, use the Mueller compression joint inlet with either copper or increasing I.P. thread outlet. Mueller inlet threads form a strong mechanical connection to the main. The compression joint, composed of a rubber sealing ring encased in a copper retaining ring, is tightened down against the main to provide a pressure-tight seal. Check your particular requirements, then contact your Mueller Representative or write direct for complete information on the corporation stop that will fit your needs.

## MUELLER CO.

*Dependable Since 1857*

MAIN OFFICE & FACTORY DECATUR, ILLINOIS

*Prefabricated aluminum roofing shown during installation at Princeton, N. J.*

*At Princeton, New Jersey...*

# PFT metal roofing on new floating cover provides longer life, better insulation

In expanding and improving its sewage treatment plant, Princeton's engineers considered immediate results *and* long-range economy, chose a *PFT Floating Cover* with *metal-clad roofing* for its new 35′ digester.

The reasons were specific—metal roofing offers four distinct advantages over conventional wood types: (1) longer life—equal to the life of the cover itself, (2) more efficient insulation, (3) fewer maintenance problems, (4) easier assembly and installation.

PFT metal roofing consists of prefabricated sections with embossed aluminum top sheets, each piece marked for easy assembly at the plant site. The sections are designed for close fitting in the field with a 3″ lap of top metal covering at all joints (see illustration). Cutout sections are provided to fit around sampling walls, hatch framing and manholes.

*The completed 35′ Floating Cover as it looks today.*

*Section of roofing showing (1) aluminum top sheet, (2) inch-thick fiber-glass insulation, (3) aluminum reinforcing channel, (4) corrugated supporting ribs.*

With fiber-glass insulation, PFT metal roofing resists heat loss and keeps digester heating costs at a minimum.

The cover is designed for later installation of PFT's *Pearth Gas Recirculation System*—an economical process that controls the formation of scum, making more effective use of the entire digestion tank capacity.

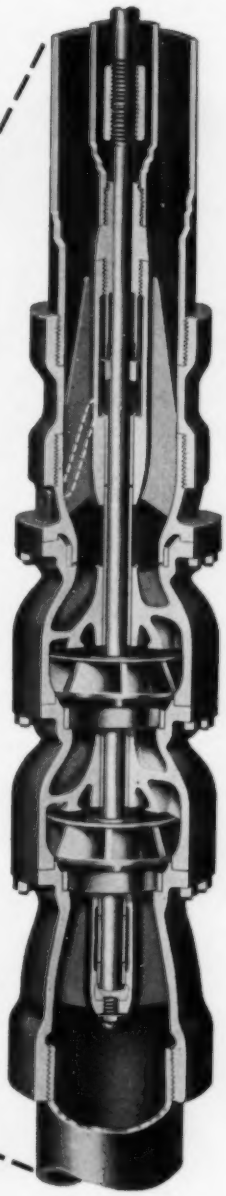
Congratulations to Princeton on their modernized plant and far-sighted planning!

*Design of plant by* / *I. Russel Riker, Borough Engineer*

P.F.T.

**PACIFIC FLUSH TANK CO.**
4241 Ravenswood Avenue
Chicago 13, Illinois

# Precision Built from Performance-Proven Design



The basic design of Layne vertical turbine pumps has been tried and proved under all kinds of operating conditions, both good and bad, the world over.

The finished pumps are produced by skilled craftsmen, in one manufacturing plant, using highest standards—Layne standards.

Industries, municipalities and agriculturalists can rely on the fact that it is prudent and safe to rely on Layne.

For example, consider Layne pump bowls—the very heart of a pump.—

★ Designed by top flight hydraulic engineers, the best available anywhere.

★ Heavy, rugged construction to give long service under gruelling conditions.

★ Clean, smooth flowing water passages in intermediates and hand-finished impellers for high operating efficiencies throughout long operating life.

★ Careful and continuous production control from design board to shipping crate—nothing left to chance.

★ Produced with the prime objective of pumping water at minimum operating cost—BETTER BUILT FOR BETTER SERVICE.

**LAYNE**
**& BOWLER, INC.**
**MEMPHIS**
General Offices and Factory

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

**Water Wells • Water Treatment**
**Vertical Turbine Pumps**

# OUR FUTURE IS (and in your

MODERNIZED **cast iron**

# IN THE SKIES... hands, too)

To keep pace with America's constantly increasing demand for water, you need the help of the elements. And the public.

We can lend a hand there.

Our national advertising stresses advance planning of water facilities... warns millions of Americans—homeowners, apartment dwellers, industrialists about waste, pollution, the need for efficient water systems. It points out the need for new water sources, adequate treatment and distribution, realistic water rates, far-sighted water legislation . . . all the facts the public must know to cooperate intelligently with you and your fellow water officials in your difficult job of keeping America plentifully supplied with water—now and in the future.

This rugged old cast iron water main, still serving and saving tax dollars for the citizens of *Detroit, Michigan,* is now in its 115th year of dependable service.

## CAST IRON PIPE. Serves for Centuries!

For over 70 public utilities in the United States and Canada, cast iron mains laid over a century ago are still serving dependably. This long, trouble-free service means lower maintenance costs... fewer tax dollars expended... fewer headaches for the waterworks officials who specify cast iron.

And today, modernized cast iron pipe, centrifugally cast, is even more rugged, uniform, durable. When needed, it's available with cement-lining to assure sustained carrying capacity throughout its generations of service.

The next time you plan extensions to your distribution system remember, cast iron pipe means the ultimate in long term reliability and economy.

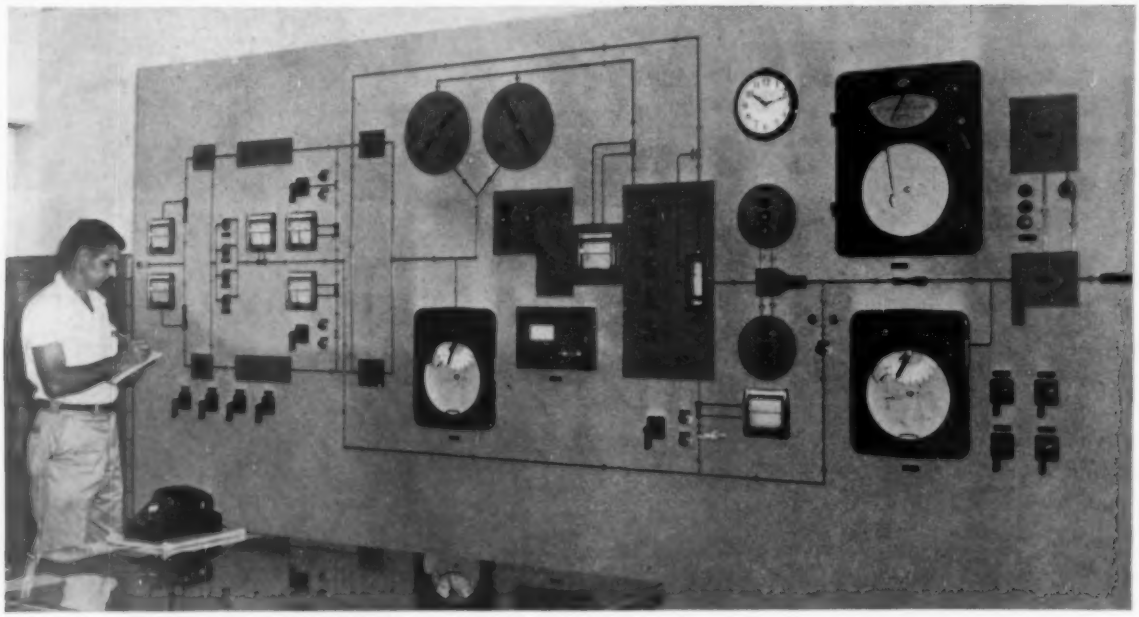
Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3, Illinois.

CAST Q IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

**pipe** FOR MODERN WATER WORKS

# NEW MUNICIPAL SEWAGE PLANT HANDLES HIGH B.O.D. EFFICIENTLY



## . . . with Foxboro Centralized Control

Strong textile wastes mixed with domestic sewage create a difficult treatment problem for the Northside Waste Treatment Plant of the city of Durham, N. C. Raw waste, averaging as much as 600 p.p.m. B.O.D., must be made safe for discharge into a small stream. To do the job with highest efficiency and economy, the plant utilizes a dual treatment process under Foxboro Centralized Control . . . produces an effluent B.O.D. of from 12 to 30 p.p.m. And a Foxboro Graphic Control Panel keeps the entire operation before the eyes of a single operator!

In addition to providing the highly accurate and efficient centralized control that this modern plant requires, plant officials cite the additional help the Foxboro Graphic Panel affords in training personnel and explaining operations to visitors. It's a typical example of the many waste treatment problems successfully solved by Foxboro Instrumentation. Get similar efficiency and economy in your operation. **Write The Foxboro Company, 8912 Neponset Ave., Foxboro, Mass.**

High B.O.D. of influent necessitates dual treatment at the Northside Waste Treatment Plant, Durham, N. C. — first with recirculating high-rate trickling filters, then with activated sludge. The Foxboro Graphic Panel (above) keeps all vital operating data constantly before one operator. Foxboro Instruments on panel measure: pH of influent and of trickling filter effluent; flow to filters; plant effluent flow; and return and waste sludge flow. *Consulting Engineers: Piatt and Davis, Durham, N. C.*

FOXBORO
REG. U. S. PAT. OFF.

**INSTRUMENTATION for WASTE TREATMENT**

No matter how farsighted today's plans may be...

## cities will grow old... in time

Famous "4 Corners," 1890— courtesy of Rochester, N. Y., Chamber of Commerce.

## Your best insurance against obsolescence of your water system...

## specify EDDY Valves and Hydrants *throughout*

No matter how far into the future your city planning is projected, Eddy's record testifies that Eddy Valves and Hydrants are your best long term investment. Eddy Valve Company's more than 100 years of dependable operation means that, today, you can get replacement parts for any Eddy Valve or Hydrant ever installed. And our ability to continue to do so is your assurance against future obsolescence of your valves and hydrants.

**EDDY Bronze-Mounted HYDRANTS** open smoothly *with* the pressure and close without water hammer. One man can easily remove all operating mechanism for inspection and repair. Positive drip action automatically drains the standpipe, safeguarding against freeze-ups. Stem held in place below hydrant valve means that there is no water loss due to a bent stem.

**EDDY Bronze-Mounted GATE VALVES** offer simplicity of design, trouble-free operation and enduring service. From the engineering drawing boards through all stages of manufacture, they are step by step a truly "finished" product of workmanship. These factors, added to personal experience, tell why progressive water works men have relied on Eddy for generations.

Eddy Hydrants and Valves are available with hub, flange or mechanical joint connections to fit any existing or planned installation.

*Send today for full data on the complete line of Eddy Valves and Hydrants. No obligation.*

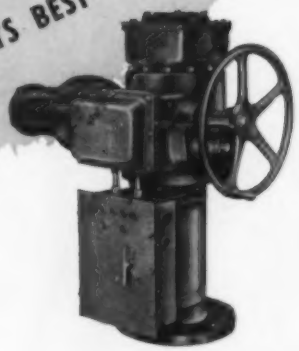
**EDDY VALVE COMPANY**

*A Subsidiary of James B. Clow & Sons*

**WATERFORD, NEW YORK**

# VALVE ACTUATION

## ENGINEERING AT ITS BEST



Motor Operated Stand with Integral Control Equipment.

Power actuation is available as a complete carefully engineered unit. Actuation may be by electric motor, air motor, or air or fluid cylinder type motivation. The power unit is compact and self contained, with sturdy supports which attach to the top of any Ludlow Valve.

Manual operation is provided for all electric and air motor operated valves. Our engineers will be glad to help you lay out a plan based on the many years of Ludlow experience in power actuation systems of all kinds for all purposes.

**"NO POSSIBLE DIFFERENCE IN FIRST COST CAN OVERBALANCE THE PERPETUAL ECONOMY OF QUALITY."**

19

MOTOR OPERATED VALVE

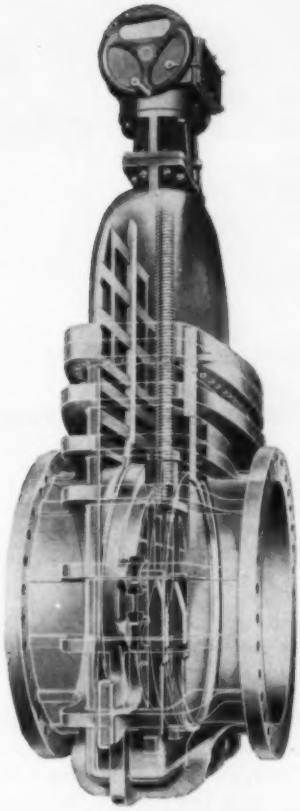
CYLINDER OPERATED VALVE

THE LUDLOW

TRADE LUDLOW MARK

**VALVE MFG. CO., INC. TROY, N.Y.**

GATE VALVES • FIRE HYDRANTS • SQUARE BOTTOM VALVES
CHECK VALVES • TAPPING SLEEVES • AIR RELEASE VALVES



# SQUARE BOTTOM VALVES

The Rensselaer Square Bottom Valve may well be called the "work horse" of the valve family. It is built to stand up under the severe conditions found in automatic operation, throttling, differential pressures and the constant opening and closing found in filtration plants and process industries.

A three-point gate support holds the downstream gate away from its seat ring at all points of travel except the final, fully closed position. Any tendency for the downstream gate to tilt and score the face of the seat ring under conditions of high water velocity or throttling service is eliminated.

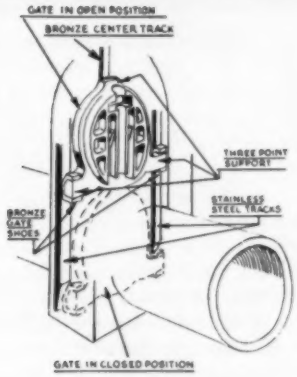
At all points this valve is built for long life under constant and severe operation.

IN OPENING: the shoes slide up the stainless steel track inclines to the higher level of the tracks, lifting the gate clear of the bronze seat ring.

IN CLOSING: the gate does not come in contact with the bronze seat ring until the closing point is reached. Even when partly open, the gate is held away from the seat, eliminating all wear due to vibration.

Rensselaer Square Bottom Valves are made in sizes from 4 to 48" with any type end connection. By-passes, spur or bevel gearing, and cylinder or motor operation as desired.

20



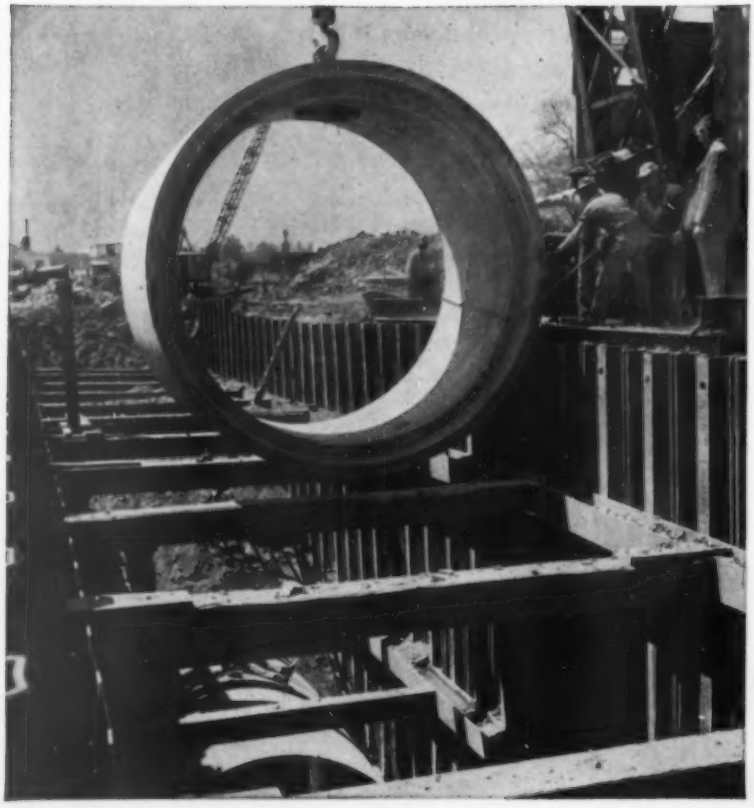

**Rensselaer**
**VALVE CO.**

DIVISION OF
THE LUDLOW VALVE
MANUFACTURING CO., INC.

*Ask for Bulletin "E"*

**TROY, NEW YORK**

GATE VALVES • FIRE HYDRANTS • SQUARE BOTTOM VALVES
CHECK VALVES • TAPPING SLEEVES • AIR RELEASE VALVES



## Louisville, Kentucky improves sewer service with gigantic

# CONCRETE PIPE

The Louisville and Jefferson County Metropolitan Sewer District is spending $1⅓ million to improve sewer service in Louisville, Ky. Its new combination storm and sanitary sewer includes some of the largest concrete pipe ever placed in the city. This 11-ft. diameter pipe (see photos), manufactured in 6-ft. lengths, has a shell thickness of 12 in. The project required 700 ft. of this pipe.

In addition, there are 200 ft. of 11-ft. diameter pipe cast monolithically on curves, 1657 ft. of precast 8-ft. pipe, 87 ft. of 8-ft. pipe cast monolithically on curves, and 974 ft. of 11-ft. x 16-ft. inverted egg pipe cast monolithically.

Like Louisville, hundreds of cities depend on concrete pipe sewers. These systems have demonstrated concrete pipe's rugged durability, great strength, maximum hydraulic capacity, minimum infiltration and leakage and unusual resistance to abrasion.

Concrete pipe sewers are moderate in first cost, require little maintenance and last for generations. The result is true ***low-annual-cost*** sewer service. Send for the free 48-page booklet, *"Concrete Sewers"*, distributed only in the United States and in Canada.

**PORTLAND CEMENT ASSOCIATION**
**Department 10-13**
**33 W. Grand Ave., Chicago 10, Ill.**

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

# In SOUTH AFRICA too . . .

# TYLOX
## Rubber
## PIPE JOINTS

***are specified to make waste lines***

- ★ ***LEAK-PROOF***
- ★ ***CORROSION-RESISTANT***
- ★ ***LONG-LASTING***

Here, a native African installs high pressure TYLOX Gaskets (bell assembly type) shipped from half way around the world to couple this pipe and protect its joints against leakage and acid attack.

The project, at Sasolburg, Orange Free State, South Africa, called for over 50,000 feet of TYLOX-jointed pipe for disposal of *both* sewerage and industrial wastes. It was a joint project of the Town of Sasolburg, and The South African Coal, Oil and Gas Corporation, Ltd. Pipe was manufactured and laid by The Roberts Construction Company, Ltd.

The question "what joint?" for this double-duty line was quickly resolved by the designers . TYLOX — which cuts construction costs by speeding pipe work, leak-proofs joints by its compression seal, and never deteriorates because of the special compounding of its rubber — was the *only* pipe joint fully meeting their requirements for pipe line economy, safety and longevity. And they were willing to go half the world away to get it.

**WRITE FOR OUR NEW TYLOX BOOKLET . . .**

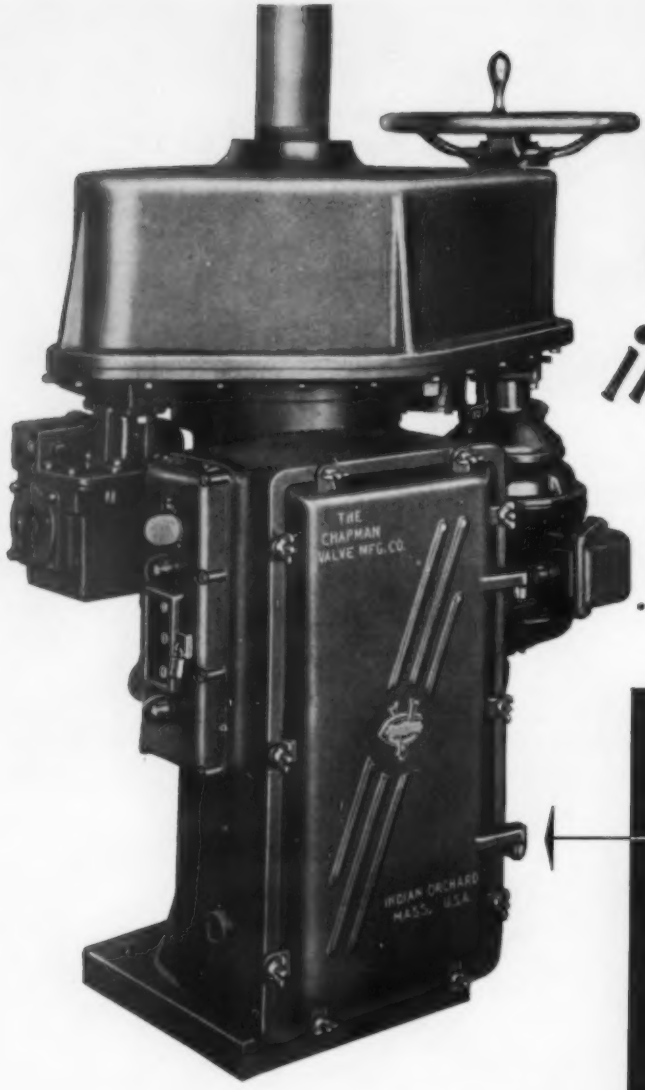
. . . read the facts on TYLOX, the only flexible joint meeting requirements of designer, builder and taxpayer alike. See why TYLOX is specified for big, important pipe jobs all over the world. Specify TYLOX to assure economy, safety and longevity on your pipe projects.

**HAMILTON KENT MANUFACTURING COMPANY**

KENT, OHIO

427 West Grant St. Orchard 3-9555

5012




# 2 TO 1 *in Your favor*

## CHAPMAN MOTOR UNITS

**...for Valves, Floorstands, and Sluice Gates**

It's a matter of simple mathematics. Take any one of Chapman's Motor Units and look it over carefully. You'll find approximately half as many parts as with any other make. This means the chances of cutting maintenance costs are two to one in your favor.

The odds can be even better. With Chapman Motor Units, you not only get simplified design, you also get sturdy construction and smooth, accurate performance over a longer period of time. There's no drift. Backlash is low. An accurate micrometer-controlled limit switch keeps seat tightness at any predetermined level.

Two points more — with Chapman Motor Units there's no trouble with either operating positions or operating conditions. Rugged stub-tooth gears require no grease or oil . . . operate at any angle . . . and the complete unit is not only weatherproof. It's *steam tight*.

Even on installation there's a chance of saving money with Chapman Motor Units. When used with floorstands they are completely wired at the factory . . . ready to connect and work. It's an easy, simple, low-cost job.

Chapman Motor Units for valves, floorstands, and sluice gates are outlined in full in our Catalog 51. If you don't have it, write for it, right now.

**THE CHAPMAN VALVE MANUFACTURING CO.**
**INDIAN ORCHARD, MASS.**

# The very first liquid chlorine made in this country sold under the brand name,

Nialk®

## ...and Nialk is still first in quality

In 100 and 150-pound cylinders, multiple unit tank cars of ton containers and single-unit tank cars of 16, 30, and 55-ton capacity.

A 100% pure product shipped in clean, well-conditioned containers with safe, tested smooth-functioning valves.

Your inquiry will receive our prompt attention.

**HOOKER ELECTROCHEMICAL COMPANY**
1712 Union Street, Niagara Falls, N. Y.

NIAGARA FALLS • TACOMA • MONTAGUE, MICH. • NEW YORK • CHICAGO • LOS ANGELES

HOOKER CHEMICALS PLASTICS

6-1674

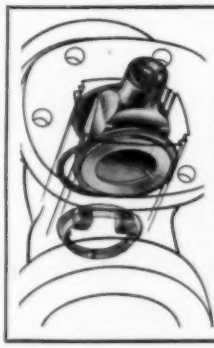
# "These new Crane AWWA Valves mean less work for me"

Everywhere these new Crane AWWA Valves have been installed, maintenance costs have dropped. Here are some reasons why:

The design of the Crane 4-piece disc assembly and guide ribs permits the trunnion-mounted twin discs to rotate freely as they are raised or lowered. Concentrated wear on both seats and discs is prevented. The simplified wedging action assures positive seating . . . tight closing. And the guide ribs prevent the disc assembly from jamming or disengaging.

Crane AWWA Valves meet all AWWA specifications. You also get the Crane 2-piece gland and gland flange with ball-type bearing. Prevents binding on stem under uneven pull-up on gland bolts.

You can order Crane AWWA Valves with hub, flanged or mechanical joint ends—in sizes 2" to 12". For complete specifications, contact your local Crane Representative, or write to the address below.



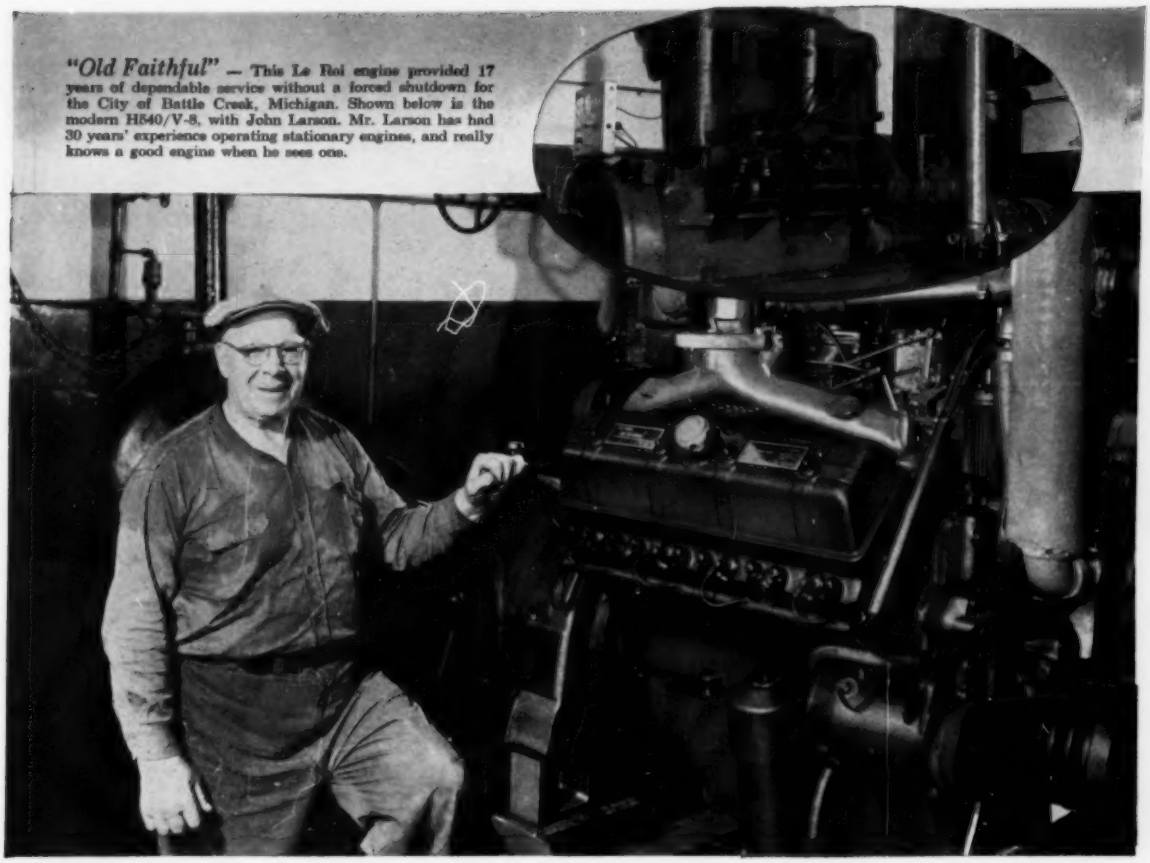
**View of disc assembly showing its simplicity. Assembly is suspended from stem, which engages upper spreader. Discs are suspended from upper spreader on trunnions. Disc flange guides hold assembly between guide ribs.**

**These valves are available with hub, flanged, or mechanical joint ends.**

**CRANE VALVES & FITTINGS**

**PIPE • KITCHENS • PLUMBING • HEATING**

*Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas*



*"Old Faithful"* — This Le Roi engine provided 17 years of dependable service without a forced shutdown for the City of Battle Creek, Michigan. Shown below is the modern H540/V-8, with John Larson. Mr. Larson has had 30 years' experience operating stationary engines, and really knows a good engine when he sees one.

# *122,105.6 hours logged with only four overhauls*

## ...dependable performance like this proves the value of Le Roi engines

In 1937, the City of Battle Creek installed its first Le Roi engine. Seventeen years later, when it was time to modernize, this engine had piled up the amazing total of hours shown above.

This is just one more example of Le Roi dependability. It is also proof of the excellent maintenance work performed by John Larson and his staff.

In 1954, "Old Faithful" was replaced by Le Roi's H540, a modern short-stroke V-8. The H540 normally operates at 1500 rpm, but, because of its short stroke V-8 design, piston speed is no greater than that of longer stroke, slower speed engines.

Moreover, the H540 provides new flexibility. This flexibility really paid off during flood conditions when the electric pumps were shorted out. The H540 ran up to 2100 rpm and, by so doing, carried the entire plant load for several days.

Performance during this emergency clearly indicated the advantages of the H540's short-stroke V-8 design. It proved that you get more horsepower per dollar and more horsepower per space. Other plus factors are easier servicing and easier installation.

Whether it's for continuous or standby service, or for pumps, blowers, or generators, it pays to use Le Roi engines. Le Roi power is dependable, low-cost power — power that can help ease the tax load in your community. You can get it in sizes ranging to 645 hp., or in custom generator sets from 50 to 350 KW. Write us for detailed information.

E-103

**LE ROI** *Division of Westinghouse Air Brake Co.*

Milwaukee 1, Wisconsin

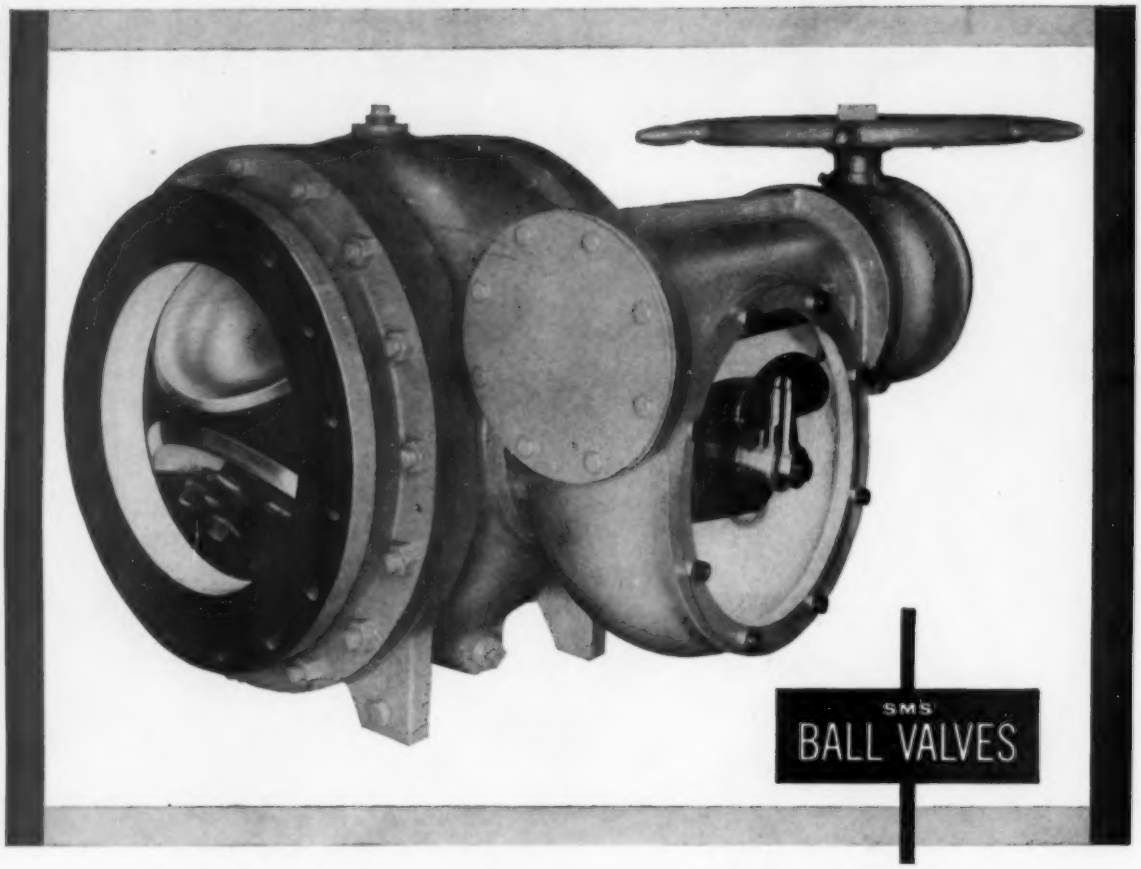
PORTABLE AIR COMPRESSORS

TRACTAIR

STATIONARY AIR COMPRESSORS

AIR TOOLS

ENGINES




# FLOW ITSELF HELPS MAKE SMS BALL VALVES EASY TO CLOSE

Flow velocity actually assists the closing operation of SMS Ball Valves. With the hydraulic action boosted by the powerful leverage of the simple link and lever mechanism (visible through the lucite cover of the demonstration model above), the valve is remarkably easy to close. The wedging action of the metal-to-metal seats assures drop-tight closure.

In the open position, the valve is like a straight length of pipe. Pressure drop and turbulence are kept to a minimum, resulting in lower pumping costs and longer valve life.

The high quality and performance characteristics of SMS valves are guaranteed by more than 75 years of research and engineering. To get detailed information about our complete line of Ball Valves, Rotovalves and Butterfly Valves, contact your local representative, or write to the S. Morgan Smith Company, York, Pennsylvania.

**S. MORGAN SMITH**

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

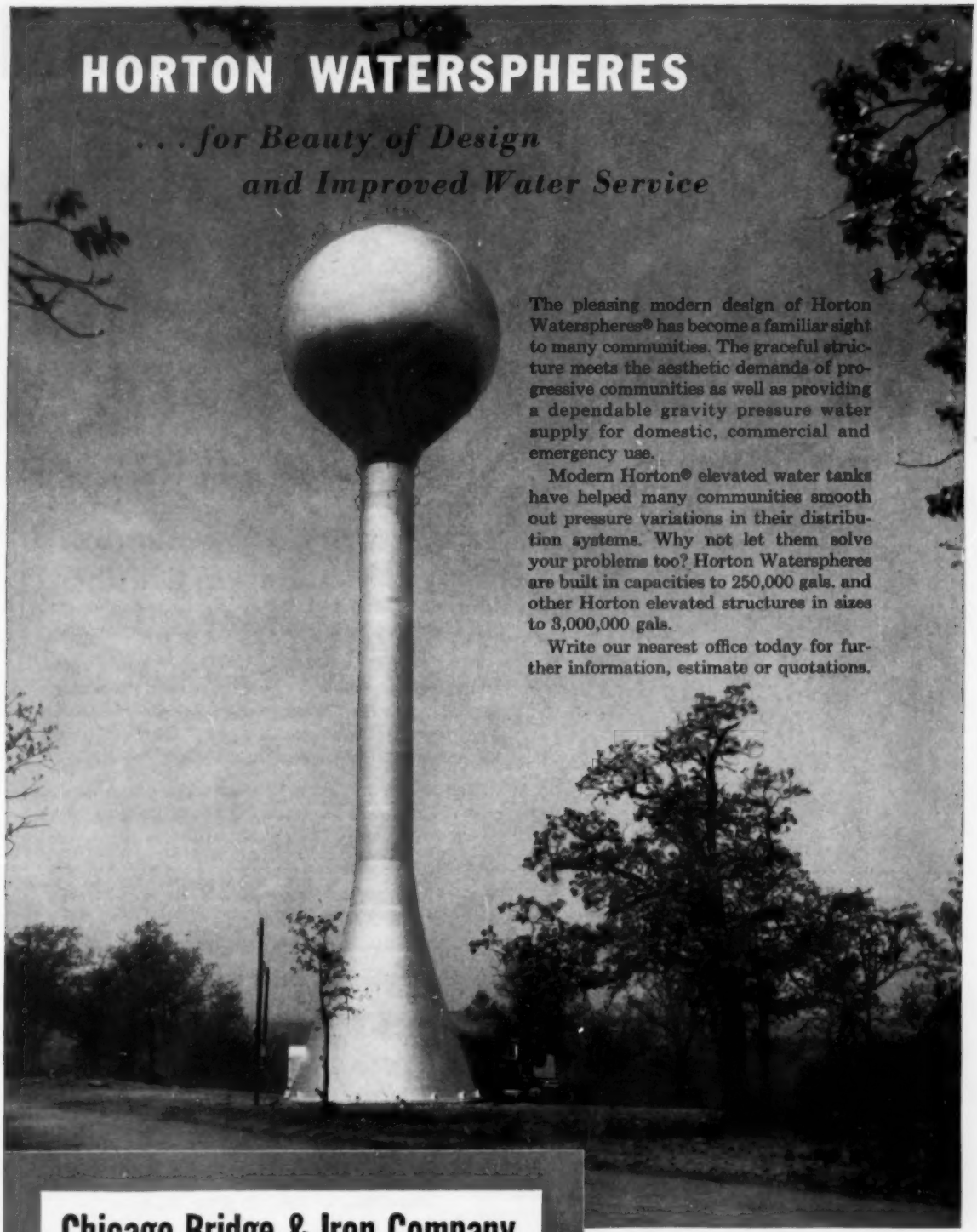
HYDRAULIC TURBINES · PUMPS · GATES & HOISTS · TRASH RAKES · ACCESSORIES

HYDRODYNAMICS

ROTOVALVES · BALL VALVES · BUTTERFLY VALVES · FREE DISCHARGE VALVES · CONTROLLABLE-PITCH SHIP PROPELLERS

# HORTON WATERSPHERES

*. . . for Beauty of Design and Improved Water Service*



The pleasing modern design of Horton Waterspheres® has become a familiar sight to many communities. The graceful structure meets the aesthetic demands of progressive communities as well as providing a dependable gravity pressure water supply for domestic, commercial and emergency use.

Modern Horton® elevated water tanks have helped many communities smooth out pressure variations in their distribution systems. Why not let them solve your problems too? Horton Waterspheres are built in capacities to 250,000 gals. and other Horton elevated structures in sizes to 3,000,000 gals.

Write our nearest office today for further information, estimate or quotations.

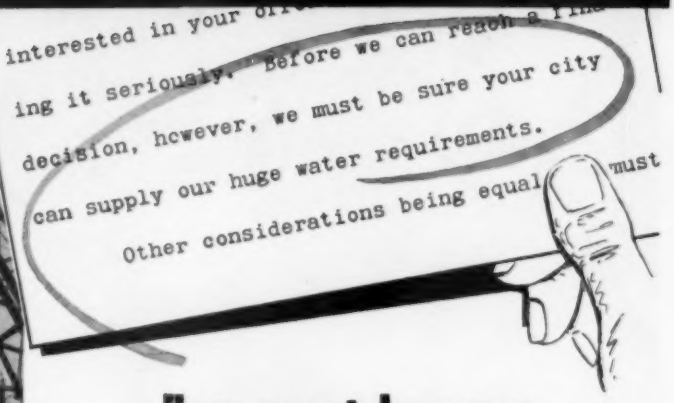
**Chicago Bridge & Iron Company**

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
New York • Philadelphia • Pittsburgh • Salt Lake City • San Francisco
Seattle • South Pasadena • Tulsa
*Plants in* BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

CBI

125,000-gallon Horton Watersphere, 92 ft. to the bottom, erected for Tulsa, Oklahoma.

# new industry wants to know—


interested in your
ing it seriously. Before we can reach a
decision, however, we must be sure your city
can supply our huge water requirements.
Other considerations being equal
must

## "we must be sure your city can supply our huge water requirements."

When an industry seeks a new plant location, this is one of the first questions asked of a community.

Executives of industry want to know that a community's water supply is ample for product processing, cooling, boiler feed, sanitation and service purposes. They want assurance of an adequate reserve capacity for peak requirements and future plant expansion.

If prospects are bright for your community's industrial development in the period ahead, don't let lack of water stymie its progress. Plan *now* to supply the water industry wants.

Equally important as *adequate* water is its *dependable* delivery. That's why —

***Permanent and Trouble-Free***

## CAST IRON PIPE

***Should Be Specified***

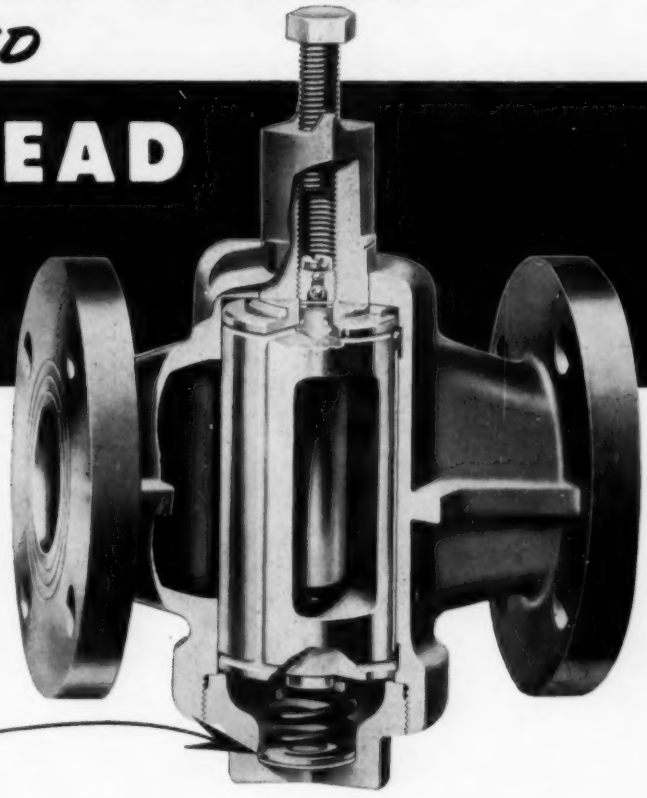
Because of its century or more of useful life, its high capacity as a carrier and negligible maintenance cost, Cast Iron Pipe has earned its reputation as

***"America's No. 1 Tax Saver."***

Our Company does not manufacture pipe but has long supplied the nation's leading cast iron pipe manufacturers with quality iron from which pipe is made.

**WOODWARD IRON COMPANY**
**WOODWARD, ALABAMA**

# No. 4* of 12 REASONS WHY
## YOU SHOULD BUY AND USE
## *LOW-PRICED*
# HOMESTEAD
## *Lubricated*
## PLUG VALVES



* SPRING TORSIONAL STRESS RELIEVED BY TEFLON WASHER

Low friction Teflon washer permits spring to turn with plug. This means that less maintenance and longer life are assured, because the spring is subjected to compression only.

This is only **one reason why you should buy and use low-priced** HOMESTEAD LUBRICATED PLUG VALVES.

## HERE ARE ALL TWELVE

1. Extra long valve life assured by very close tolerance between sealing surfaces.
2. Straight line fluid flow—streamlined ports—minimum resistance to flow—minimum pressure drop.
3. Triple head seal—two lubricant rings and reinforced Teflon stem seal prevent leakage.
4. Easy turning—plug floated on Teflon washer and reinforced Teflon ring.
5. Leak-proof double ball and lubricant sealed check valve. No springs. No maintenance.
6. Full-threaded screw prevents dirt being forced into lubricant system.
7. Quarter-turn fully opens or closes.
8. Reinforced Teflon stem seal—no cold flow—continuous, positive seal.
9. Seating surfaces protected in both open and closed positions.
10. High pressure lubricant system provides full lubricant seal around ports.
11. Self-freeing plug prevents sticking.
12. Two lubricants handle most services.

**FOR CATALOG AND COMPLETE DETAILS MAIL COUPON TODAY**

**HOMESTEAD**
VALVE MANUFACTURING COMPANY
*"Serving Since 1892"*

P. O. Box 42 Coraopolis, Pa.

**Without obligation, send Reference Book 39—Section 5 on HOMESTEAD LUBRICATED PLUG VALVES.**

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

**FOR BETTER RESULTS**
**WITH LESS TROUBLE**
**...PICK *ONE***
**INSTEAD OF TWO**

## 1½" or 2" Style 3 Meter matches performance of complicated compound . . . with less cost and fuss

For 1½" and 2" water service lines, the Trident Style 3 meter is simpler, costs less to buy and maintain, is every bit as accurate, and produces just as much revenue over a wide range of flows as any compound, including our own. Trident was *first* to give you an easy-to-set pressure adjustment. And since modern Style 3 parts fit older meters, there's never any obsolescence.

So why put up with the fuss and expense of *two* measuring units when *one* Style 3 will do the job? You'll find conclusive evidence in your own records . . . or ask your Neptune man.

278

**NEPTUNE METER COMPANY**
19 West 50th Street • New York 20, N. Y.

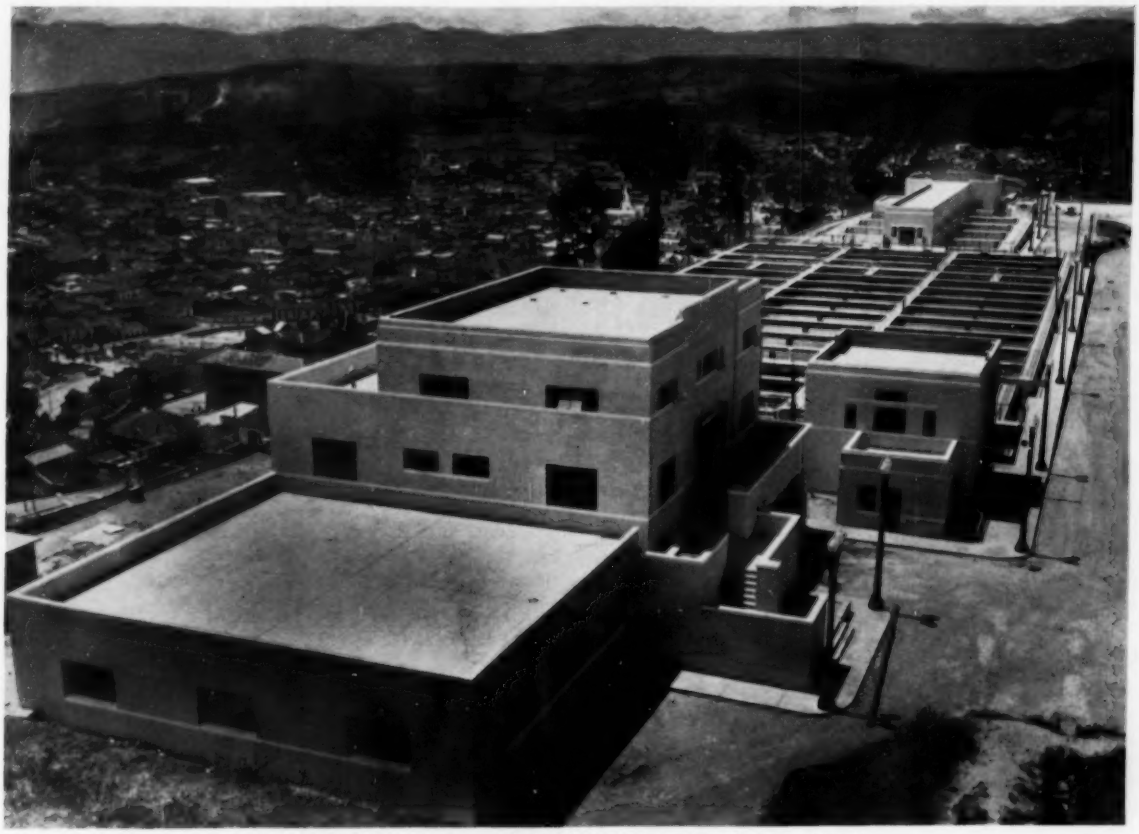
**NEPTUNE METERS, LTD.**
1430 Lakeshore Road • Toronto 14, Ontario

*Branch Offices in Principal American and Canadian Cities.*

neptune

WATER & SEWAGE WORKS

VOL. 103, NO. 12 • A Scranton Gillette Publication • DECEMBER, 1956



QUITO'S New 14.5 mgd El Placer Water Purification Plant
Chemical Bldg. in foreground; Filters and Administration Bldg. at far end

# The New El Placer Water Purification Plant

For venerable Quito, Ecuador, founded by Spaniards just 415 years ago.

by Dr. GEORGE C. BUNKER
Consulting Engineer
Panama, R.P.

WITH a modern water purification plant now in operation 415 years after it was founded by the Spaniards, Quito, Ecuador, joins the ranks of the several cities of South America which now have modern and safe water supplies.

Quito, (population 225,000), at an elevation of about 9,200 feet above sea level, and but 16 miles south of the Equator, is the second highest capital in the world and the nearest of any capital to the Equator. For a time during the latter part of the 15th century Quito was one of the capitals of the vast Inca Empire, under the name of Quitus. Indian runners brought fresh fish from the Pacific Ocean and ice from the Mountains for the pleasure of the Emperor Atahualpa. A railroad of 281 miles

**GEORGE C. BUNKER, Dr. Eng.**

**The author is Exec. Vice President and General Manager for Harold T. Smith, Engineers, with offices in Panama, R.P., Washington, D.C. and five other countries.**

**Dr. Bunker's home office is the Panama office. He pioneered water purification for the Panama Canal, has served as consultant to several South American countries and has been specially cited with awards, medals, etc. in recognition of his services.**

now connects Quito with the Pacific Coast metropolis of Guayaquil, the principal port of Ecuador.

Quito is surrounded by peaks of the Western Range of the Andes, some of which are extinct volcanoes, while a few show occasional signs of activity. The city lies directly at the foot of the now inactive volcano Pichincha, an eruption of which occurred in 1868 and damaged many of Quito's buildings.

The new water plant obtains its name, El Placer, from the site on which it is located. It replaces an old slow sand filtration plant which was of inadequate design and size to purify the mixture of surface and spring waters conveyed to it by a combination of open canals and pipelines. The resistance to demolition, shown by the walls of the old filters built of brick and stone masonry, was surprising and dynamite had to be used to shatter them.

By erecting the new plant on a narrow ridge with steeply sloping sides, which governed the general layout, it is only a short distance from the old section of the city, and permits use of an existing distribution reservoir at a lower level, thereby saving the cost of a new one. A hill close to and back of the plant furnishes a good site for a concrete reservoir to function both as a wash water tank and a distribution reservoir for three high level districts of the city. Advantage was also taken of the head that was available in one of the raw water pipelines to include a small hydroelectric installation in the plant for generating electric power.

## The El Placer Plant

The nominal capacity of the plant at a rate of filtration of 2.0 g.p.m. per square foot of sand area is 14.5 million gallons per 24 hours. It consists of the following units: a chemical treatment building; a small tank for the preliminary blending of the three raw water supplies; two flash mixers; three parallel flocculating basins, each of which is 45.9 by 33.45 feet in plan by 14 feet deep; three parallel sedimentation basins, each of which is 213.3 by 39.37 feet in plan by 16.5 feet deep; two rows of four filters each, adjacent to the outlet ends of the sedimentation basins, which are separated by pipe and filter operating galleries; an administration building adjoining the superstructure over the operating floor of the filters; a filtered water reservoir with a capacity of 909,000 gallons; a wash water reservoir with a capacity of 414,230 gallons; and a small building with a Pelton water motor and a 125 KVA generator. All of the hydraulic structures are constructed of reinforced concrete.

### Chemical Treatment Building

This building, 62 by 96.45 feet in plan, is designed with a reinforced concrete frame and curtain walls of brick. The basement of the building is primarily a storeroom for chemicals, but it also provides space for a bag elevator, equipment for a pressure water suppy system, and storage of miscellaneous articles.

The southeast half of the basement is extended to a vertical height of 33.8 feet to provide two floors and space for the facilities required for the operation of the plant. On the first floor there is a lobby, a room for two alum dry feeders and two continuous lime slakers and gravimetric feeders; one activated carbon feeder; chemical and bacteriological laboratories; an office; sanitary installations; and a storeroom.

In the lobby there are two-unit panel stands with electric receivers each consisting of an indicator, recorder and totalizer, for flow measurements, actuated by electric transmitters installed at the Venturi meter in each of the three raw water pipelines and in each of the two supply mains from the wash water reservoir to three sections of the city in the high level service zone of the distribution system and an indicator of the raw water level in the preliminary supply blending tank.

The bag elevator lifts the chemicals to the second floor through which the hoppers of the chemical feeders project. The discharges from the solution vats of the chemical feeders flow by gravity through hose lines to a rubber-lined steel box set near the flash mixers. The box is divided into three compartments provided with stainless steel weir plates. The chemical solution which flows into each of these compartments passes through the weir into an adjoining smaller compartment and enters a stainless steel funnel inserted in a 2-inch rubber hose which discharges into the water flowing into the flash mixers.

### Mixing, Flocculation and Sedimentation

The three raw water pipelines and the water motor discharge into a baffled concrete tank for a preliminary blending of waters which then flow over a weir to enter the two flash mixers with a theoretical detention of 18 seconds. The effluents from the flash mixers enter a concrete con-

duit with horizontal disc valves which distribute the water into three flocculating basins, with a theroretical detention period of 45 minutes. The coaguated water flows into three sedimentation basins through vertical slots in concrete walls, with a theoretical detention period of 4½ hours. From the outlet end of each basin the water flows over a weir into a collecting channel, extending across the entire width of the three basins, and thence in a covered concrete channel adjoining the exterior wall of each of the two rows of filters.

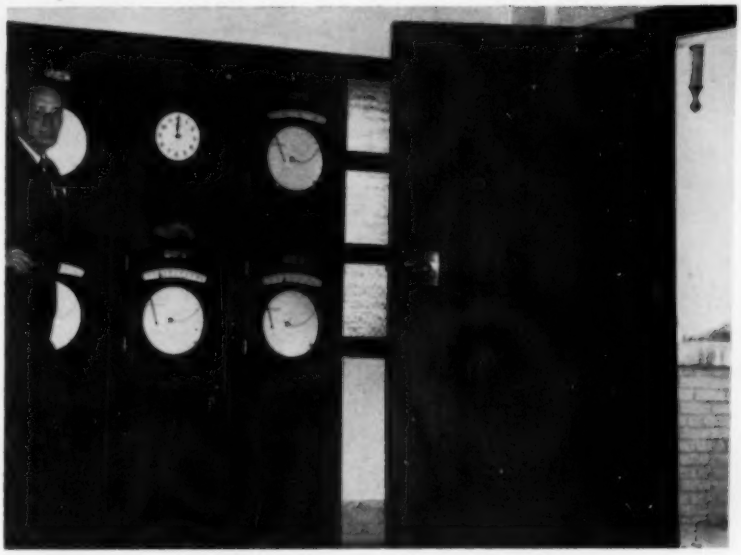
### Rapid Sand Filters of Gravity Type

Each of the eight filters consists of two sections, separated by a gullet, which are 12.8 by 24.6 feet in plan by 12.8 feet deep. The settled water enters the gullet of each filter from the channel, adjoining the exterior wall, through a sluice gate with a hydraulic cylinder which is actuated from a table on the filter operating floor. Concrete wash water troughs discharge into the gullet.

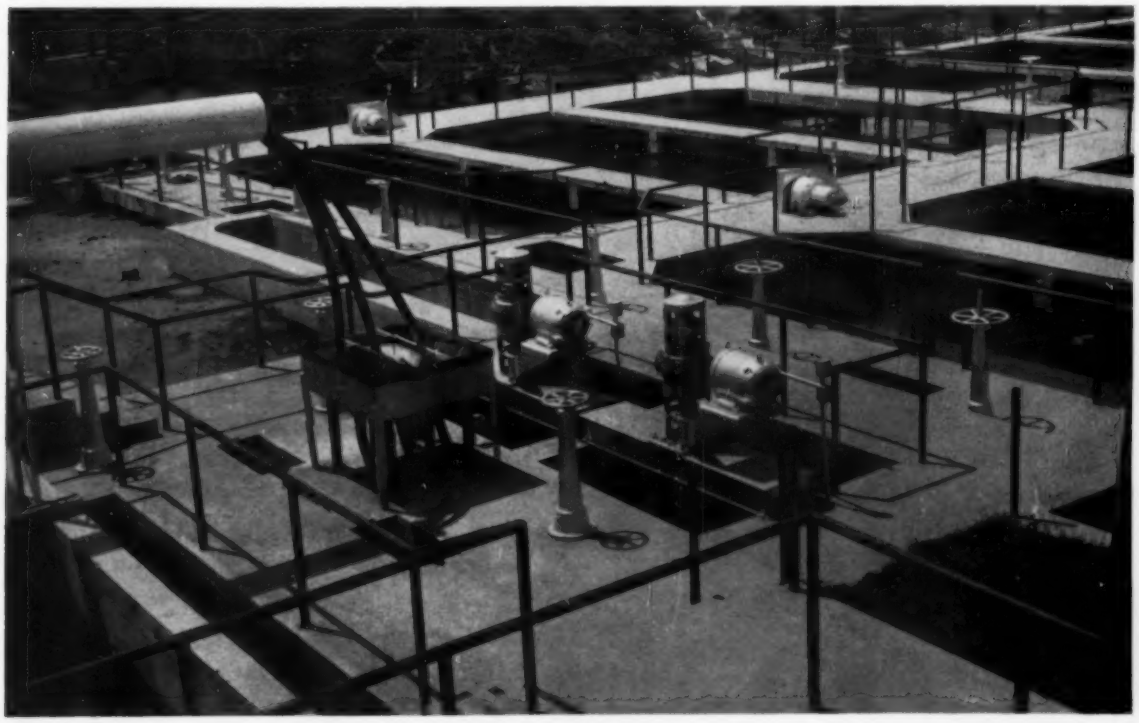
The filters are provided with Wheeler bottoms; 12 inches of gravel of four sizes; four inches of torpedo sand and 24 inches of sand with effective sizes of 0.80-1.20 mm. and 0.45-0.50 mm., respectively, and with a maximum uniformity coefficient of 1.70 mm. for each class of sand.

A superstructure, of reinforced concrete frame and brick curtain walls, with windows and doors, covers the operating gallery, 16.4 feet wide, between the filters which are uncovered. The operating floor is covered with tiles made in Quito.

All of the piping in the pipe gallery consists of Armco spiral welded steel pipe lined with coal-tar enamel in a plant constructed by the Contractor for coating and lining the steel mains



**INSTRUMENT panel in entrance lobby**



**RAPID mixers and flocculators**

Note rubber hose lines from feeders to chemical solution distribution box

**FILTER operating floor**

used in the distribution system. All of the fittings, with the exception of a few cast iron specials, were fabricated of steel pipe by Ecuadorean welders. The valves, with the exception of those of 4" size for wasting filtered water, are operated by hydraulic power from tables in the filter operating gallery.

At the rear end of the pipe gallery there is a combined controller and meter in the wash water main to the filters, with an electric transmitter, to indicate the rate of flow during the backwashing of a filter on an illuminated gage on the filter operating floor. There is a reinforced concrete conduit in the pipe gallery into which the effluent from each filter discharges. A controller is provided for each of the two sections of each filter. The top of the conduit serves as a walkway through the pipe gallery.

Under the pipe gallery, on each side of the above conduit, there is a separate reinforced concrete conduit which conveys the spent wash water from the filters to a concrete chamber at the rear end of the gallery from which the water flows into a concrete drain.

### Administration Building

Adjoining the superstructure over the filter operating gallery, there is a building 61.63 by 38.35 feet in plan, with a basement and one floor above it. Adjoining one side of the building there is a storeroom for chlorine cylinders.

In the basement there is a room for a gravimetric feeder and continuous slaker. The remaining area is utilized for the equipment for a pressure water supply system and a shop. There is an opening in the common wall between the filters and the basement for access to the pipe gallery. In the opposite wall there is a small chamber with a pit door at the ground surface and above it an "I" beam with a trolley hoist for the handling of valves or fittings in the pipe gallery in case they must be removed.

On the first floor of the building there is a lobby with marble trim, and rooms for an office, lime storage, chlorinators, a sanitary installation and a small storeroom. An opening is provided in the wall adjoining the superstructure over the filters for access to the operating floor.

In the lobby there are three two-unit panel stands with electric receivers each consisting of an indicator, recorder and totalizer for flow measurements, actuated by electric transmitters installed at the wash water controller, the Venturi tube in the wash water pumping main, the combined controller and meter in each of the two supply mains from the filtered water reservoir, and in the supply main from the low level distribution reservoir, located a short distance below the filtered water reservoir.

### Turbine and Generator Building

This small building adjoins one end of the preliminary raw water blending tank and contains: a Pelton water motor and a 125 KVA, 240-volt, 3-phase, 60 cycle generator for developing power to operate the motors of the equipment required for the treatment of the raw water and of the wash water pumps, and for the general illumination of the plant; the electrical equipment for controlling and distributing the power; and the transformers for standby power from a line of the municipal power company. Advantage is taken of a head of 725 feet in one of the three raw water supplies to install a penstock

**PIPE gallery between two rows of four filters**

Note the use of light weight steel pipe, valves and fittings

of steel pipe to operate the water motor.

### Filtered Water Reservoir

The filtered water, to which chlorine and lime have been applied, flows into a new covered reservoir, of two sections, with a capacity of 909,000 gallons, located near the Administration Building. The filtered water is distributed across one side of the reservoir through openings in a conduit under the roof.

The capacity of this reservoir is based on utilizing its elevation to supply water by gravity to three distribution reservoirs and directly to one section of the city in the intermediate level service zone of the distribution system.

Two short coupled vertical turbine pumps with electric motors are installed on the tiled roof of the reservoir for pumping water to the wash water tank through a steel pipeline. An electric transmitter, a water level indicator and the starters for the pumps are located in a small brick house on the roof.

The purification plant was included in a municipal contract with Harold T. Smith, Inc., Engineers and Contractors, covering the design and construction of a new potable water supply system for the South Zone of the City with a loan from the Export-Import Bank. The same firm completed several contracts during preceding years for supplying and distributing potable water from deep wells for the North Zone of the City. The key personnel of the contractor in Quito are: Parker Dawes, Manager; Frederick H. Donovan, Construction Superintendent; Henry F. Maunder, Auditor; and Emilio Husserl, Office Engineer. The Municipality is represented by Oswaldo Bahamonde, Director of the Water Department.

**EQUIPMENT SUPPLIERS**

| | |
|---|---|
| Wheeler Bottoms, Sand and Gravel, Operating Tables, Disc Valves, Slide Gates, Filter Specials and Service Water Supply Systems | Roberts Filter Manufacturing Co. " " " " " " " " " " " " |
| Chemical Feeding Equipment* | Omega—Builders-Providence, Inc. |
| Meters, Controllers, Gages and Chlorine Feeders* | Builders-Providence, Inc. " " " |
| Bag Elevator* | Link Belt Co. |
| Pelton Water Wheel and Generator | Westinghouse Electric International Co. |
| Hydraulic Valves, Gate Valves and Sluice Gates* | Iowa Valve Co. " " " |
| Flash Mixers and Flocculators* | Dorr-Oliver, Inc. |
| Laboratory Supplies | Phipps & Bird, Inc. |
| Wash Water Pumps | Layne & Bowler, Inc. |
| Motors for Wash Water Pumps | U. S. Electric Motors, Inc. |
| Steel Piping | Armco International Corp. |
| Dresser Couplings | Dresser Industries, Inc. |

*The Roberts Filter Manufacturing Co., assembled all of the equipment from the suppliers and installed it in the plant.

# Long Range Planning for Water Service*

**Requires some revision in past thinking and a raising of sights, looking to realistic service.**

**by ABEL WOLMAN, Dr. Eng.**

**Dr. Wolman, who needs no introduction to readers of this magazine, heads the Dep't. of Sanitary Engineering and Water Resources at Johns Hopkins Univ., Baltimore, Md. He is consultant to many municipalities and longtime chairman of AWWA's Committee on National Water Policy.**

THE RECORD in the United States for providing people with water service is one of which any citizen might be justly proud. Perhaps in no other country in the world has public water supply been so universally afforded at such low cost as in this country. Why then should one still concern himself with the subject of long range planning for water services.

The history of water service demonstrates that the problems of planning have long confronted the professional practitioner. Emphasis on such planning is not new. The literature in the water works field is filled with careful technical consideration of the complex problems of providing water.

In the last two decades the nature of such planning, however, has in some respects been modified. The long look at the water issues which now concern the professional worker discloses a somewhat different and broader aspect. One of the major characteristics of water supply service in the past has, with some important exceptions, been that it has been confined largely to the development and extension of water service within limited political boundaries, usually those of the familiar municipality. These problems within such circumscribed areas have been resolved over the years with skill and with economy. Where the solutions have fallen behind in actual execution, the causes have been essentially of political, administrative and fiscal natures.

### A New Set of Issues to be Dealt With

Today, however, we are confronted with a new set of issues, which represent the subject matter of this paper. The changes which create new or intensify old problems are those which we generally ascribe to metropolitan areas. The phenomena associated with the growth of the metropolitan areas are of relatively recent origin. They confront the developer of water service with issues broader in scope, wider in geographical coverage and more amorphous than previously. The metropolitan areas likewise represent a nationwide, rather than a local or regional, development. It is within this particular setting that the long range planning of water service is here discussed.

### And, New Areas for Service

In 1956 approximately 172 metropolitan areas of well defined characteristics exist in continental United States. Some 42 states and the District of Columbia are represented by such areas. Only the states of Idaho, Montana, Nevada, North Dakota, Vermont and Wyoming do not contain at least some areas within the current Census Bureau definition.

More than half of the nation's population now lives in metropolitan areas. Something approaching 90,000,000 people are thus accounted for.

Not all of these areas, of course, are enormous in size, although there are 33 of these which have populations in excess of 500,000. The areas apparently are growing in acreage and in population and will undoubtedly by 1960 account for over 100,000,000 people.

The significance of these figures lies in the fact that the country was generally unprepared to meet the utility requirements of such areas which spilled beyond the political units normally geared to meet such requirements. The unfortunate results of this lack of preparedness, not only in technology, but in administrative structure and finance, are a familiar story.

Efforts to meet these growing problems, in relatively unfamiliar settings, have ranged all the way from the successful devices used for years in the Boston Metropolitan District and in the Washington Suburban Sanitary District to completely chaotic and "hand-to-mouth" operations in most other metropolitan areas. In these latter cases, the situation has successfully escaped the impact of careful advance thinking. As a result, the next quarter of a century will obviously show the necessity for major reconstruction, considerable duplication in expenditures or increasingly limited water service.

Both private and public workers in this field have defaulted in visualizing realistically the nature of the problem or have been slow in activating new solutjons. The orthodox water planning, geared to restricted geographical areas and to the considerations of earlier decades, has inhibited more imaginative solutions. The traditional political boundary has perhaps played an unfortunate part in restraining water service, whether publicly or privately owned, even though at the same time it has provided many skillful technological aids. An awareness of these realities is a

*A paper presented before the Pennsylvania Water Works Ass'n. It is being published in *Water and Sewage Works* by authorization of the Association.

pre-requisite to solving problems which new and unexpected demands have posed.

## Guiding Principles

It is not the purpose of this paper to present a check list of the items to be kept in mind in planning for water service. Such check lists have been authoritatively presented in the professional journals. Little needs to be added to them, since they afford excellent and detailed guide lines for the interested worker.

The most useful contribution would be to discuss those guiding principles which must be militantly confronted, if we are to recover and to guarantee adequate water service in the metropolitan areas. These principles may be assumed to cover some five major areas, as follows:

(a) Technology
(b) Administrative Structure and Management
(c) Finance
(d) Research
(e) Legislation

### (a)—Technology.

Although it may be stated with some assurance that the technological prospect of providing water service in metropolitan areas is the most optimistic, one should not lose sight of the fact that even in this particular function much remains to be done to diagnose and to expand the quality of water service. Perhaps one of the most critical features in this field is the rising evidence that the water works practitioner has too often neglected the complex problems of distribution. The present emphasis on distribution diagnosis and design has its root in the same traditional adherence to more densely populated areas already referred to. If people had not elected in the last two decades to move in increasing numbers to broader and less dense areas and to properties with more lawn space, the orthodox water distribution design would have served without serious defects.

These suburban shifts in demand are the subject of a wide variety of diagnostic studies in many parts of the United States. They represent a growing recognition of the fact that the changing demands for water force a prompt and new evaluation as to how best to distribute it. The situation obviously will not be met by bemoaning privately the extraordinary habits of the American people and by resisting to the last ditch their insistence to be allowed the use of water for purposes which they prefer and in amounts which they desire.

The prime necessity in technology is an immediate evaluation of these requirements. At the same time the translation of these requirements into actual availability has always taken too long. The author recently reviewed the steps required to complete the construction of the Savage River Dam in the State of Maryland. The dam was designed to increase the low flow of the Potomac River for water supply and stream pollution abatement requirements. The proposal for this project was initiated prior to 1931. Its development wandered through decades of fits and starts, several wars, a depression, minor financial emergencies, international diplomatic battles, controls of materials and labor, and repeated efforts for the raising of additional moneys.

In 1951, more than 20 years after the initiation of the idea, the dam was finished and ready for operation, with water actually being released to afford the benefits originally contemplated.

The experience of New York City in the development of its additional water sources over the last quarter of the century is a further demonstration of the long time lag which has plagued the water works industry throughout its history.

These delays, of course, were not due to technological deficiencies, but to man-made obstacles, aided and abetted by the snail-like processes which control most public practice throughout our history. It is unfortunate that many people now adopt the fatalistic attitude that nothing can be done to speed up the processes in water utility service in this country. The time lag cannot be accepted for the forthcoming decades, since the problems are at our doors for immediate rather than for deferred decision and action.

In this respect, the technological issues and solutions may be used as the tools for speed rather than as the bases for delay.

### (b)—Administrative Structure and Management.

Much too little consideration is still being given to the development of administrative devices designed to provide answers to the problem now confronting us. For the most part we still struggle with rural county administration to solve essentially urban utility problems. By and large, we still view the core municipality as the primary agent to restrict water service to surrounding areas. We still tacitly insist that the satellite areas design and install the water utilities on the most niggardly basis in order to keep within the philosophical scope of the revenue bond. Almost without exception these practices result in inadequacies of system and of service, in the piling up of problems for the future and in intensifying the general feud between the subdivider, the house owner, the county government and the water utility.

Opportunities for the consolidation of service are great. Obstacles to such accomplishments are equally great. They stand, however, as challenges rather than as reasons for no action.

There are, of course, excellent examples of intelligent long range approaches to satisfactory administrative practice. Some of these antedate by years the nature of the problems here described. One should remember that some of the sanitary districts and authorities, operating successfully for decades, were created in the period from 1915 to 1925. They are monuments to the imagination, vision and the long range planning instincts of distinguished engineers, administrators and political statesmen.

In view of their existence, as well as of their success, it is disconcerting that the lessons to be learned from them have not been more widely applied.

The most perfect diagnosis and design of a water utility in an expanding area is in a way fruitless, unless there also be an equivalent diligence in translating such a proposed system into an actuality by the creation of the agencies (if need be) which could accomplish such purposes.

### (c)—Finance.

One of the major blocks to the provision of adequate service in most metropolitan areas is in the field of finance. Here again, the principles guiding us in the past, with some exceptions, are not adapted to the requirements of the present and the future. In order to circumvent the problems of tax limitations, the last few decades have been characterized by the ascendency of the revenue bond as the savior of the water works industry. However, that it alone cannot save the industry should be apparent to any careful investigator of the metropolitan problem.

The revenue bond rests upon the assumption that the user of water is naturally the sole base of payment for the system. This fundamental principle is more apparently valid than it is in reality. It was probably close to the truth when the new consumer represented a small and leisurely addition to the total body of consumers, when the system was compact in nature and in coverage, when the area was either static or

slow in expansion and when the design could keep reasonable pace with the growing requirements of a compact community. Most of these characteristics are inapplicable to the metropolitan areas as we now know them.

Few are willing to acknowledge that the general ad valorem tax and the front foot assessment are essential ingredients of any rapidly expanding water economy. The pursuit of the revenue bond principle to its bitter end in many metropolitan areas has resulted in undersized systems, in inadequate operation, in the almost complete absence of long range plan and in the ultimate scrapping of a good many small systems independently financed. All of these untoward results stem from the fact that the present and future participants are unwilling to accept the axiom that a water distribution system is an integrated entity and not a series of independent units designed and constructed without regard to the ultimate form and balance of an integrated system.

What we see now are minimum sizes of mains for satellite communities, each clinging religiously to a revenue bond principle, wholly inadequate to finance the present or the prospective requirements of the area. The eye is focused on the immediate, whereas the true solution must provide for the next 40 to 50 years.

It is interesting to speculate how long it will be before we might all confess that the water utility of the future, within the areas here discussed, must rest upon the combined base of more than one of the following sources of money.

(1)—The ad valorem tax for the larger sized mains and plant additions required for adequate future service.

(2)—The front foot assessment for the individual house.

(3)—The water consumption payment by the actual user.

To place *all* the emphasis upon the third of these sources of revenue, in the kind of setting which now confronts some 100,000,000 people, is unrealistic if not already fatal. In addition, such a choice either results in a poor system, or loads the present consumer with burdens which in part belong to future consumers.

### (d)—Research.

One cannot speak of long range planning for water service without a major emphasis upon the things which we do not know. The range of opportunities for research and development is great. It moves over the entire spectrum, from automation to detailed analysis of the impact of the behavior of people upon water use.

We have adhered too long to the assumption that our design should rest upon the fact that historically the ratio of the maximum day consumption to the average day should approximate 150 per cent. Man has a habit of deviating from the professional's rule.

The professional may elect to ignore man's demands or he may adjust his diagnoses and his solutions to the inevitable. The fantasy of planning for a water works expansion independent of and unrelated to the desires and habits of the public may be entertaining, but is certainly a fruitless effort.

Research should point the way to how the long range determination of water works needs may be used as a guide for the design and redesign of systems and for their adequate financing and management.

### (e)—Legislation.

If any of the guiding principles so briefly noted above are to find full implementation, major adjustments in legislation will be required in most parts of the United States. It is not asking too much that the water works practitioner should devote an increasing amount of time to the determination of the kind of legislation so required. He must, in addition, actually prepare or participate in the preparation of such legislation. He must undertake to press for its passage, he must roam the halls of legislative assemblies to advise, to persuade and to coerce the development of such legislative sanctions.

It is not enough to bemoan the absence of such legislation or to point out that the engineer is not the logical or appropriate agent for the stimulation of such enactments.

Unless the engineer engages in such activities, the probability of crystallizing better practices and meeting the water demands of the future more promptly are exceedingly low.

## The Long Range Objective

Water service of an adequate nature, at a reasonable price, is an attainable objective.

If this has not yet been attained, it is only because the skilled workers in this field have not seen fit to define the objective, to delineate the principles which should control its implementation, to devise the form of structure for administration and management and to establish the fiscal principles which might safely and wisely provide the sinews for the project.

All of these opportunities are at hand. Many of them have already been partly crystallized.

What is lacking is the enunciation of the guiding principles in detail, their acceptance in fact and their translation *militantly* into reality. Such a prospect is an exciting one.

If this paper has done nothing more than to press forward such undertakings, it will have accomplished its major purpose.

## A. R. Todd Now Devoting Full Time to Engineering Practice

A. R. Todd, consulting sanitary engineer of Wheeling, West Va., announces the necessity of resigning from his part time position as superintendent of water treatment at Wheeling, W. Va., in order to do justice to his growing consulting practice in water supply and sewage disposal and industrial waste treatment.

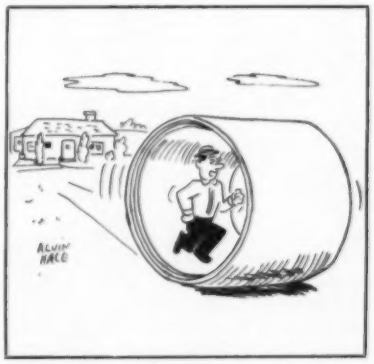
Under the name A. R. todd Associates, Inc. his full time engineering office is located in the National Bank of W. Va. Bldg., 1201 Main St., Wheeing, W. Va.

## Floyd G. Browne Establishes Partnership

Floyd G. Browne, consulting engineer of Marion, Ohio, announces the formation of a partnership under the name Floyd G. Browne Associates.

Participating in the new partnership are S. W. Kuhner, C. Robert Martin, W. G. Smiley, Grant M. Hinkamp and Wayne H. Kuhn.

"Them what can brag without lying, let 'em BRAG!"



**"NICE of the boys to leave this pipe right in front of my lot. Now I won't have to buy a lawn roller."**

# WATER WORKS PRACTICES

## Properties of Water—I

### Physical Properties

The Thirty-sixth of a series

by GEORGE E. SYMONS, Ph.D.*

**In this series, Dr. Symons discusses Water Works Practices in the form of short school lectures designed to assist operators, students and others who wish to review fundamentals in this field.**

IN ORDER TO understand the treatment and use of water, it is necessary to know something about water itself, its composition, structure, characteristics and behavior; in short, its properties. This lecture is designed to set forth fundamentals on the physical and chemical properties of water.

#### A . . . Structure of Water

1 . . General

**a.** Water is so common in chemical reactions that we often assume it to undergo no change and to be homogenous and inert, but this is not true.

**b.** Water, however simple it is expressed to be in the usual formula, is in reality, a complex mixture.

*(1)* It is never absolutely pure.

*(2)* It is not simply $H_2O$.

2 . . Molecular Composition

**a.** The complex molecular composition of water results from the fact that there are three forms (isotopes) each of hydrogen and oxygen.

*(1)* The three forms of hydrogen are $H^1$, $H^2$, $H^3$, or Hydrogen (H) Deuterium (D) and Tritium (T); the numbers represent the different atomic weights.

*(2)* The three forms of oxygen are $O^{16}$, $O^{17}$, $O^{18}$, the numbers indicating different atomic weights.

**b.** From these six isotopes there are 18 possible combinations from simple $H_2O$ with a molecular weight of 18, to $T_2$ $O^{18}$ with a molecular weight of 24.

**c.** There are also 15 types of ions possible in water, from $H^+$ and $OH^-$ to $T^+$ and $O^{18}T^-$. (Ionization is a subject that will be dealt with in the discussion of the chemical properties of water)

**d.** Thus there are 33 different forms present in pure water.

*(1)* $D_2O$ or heavy water may be present to the extent of 200 mg/L.

*(2)* $O^{18}$ compounds may be present to the extent of 1000 mg/L but are similar to $0^{16}$ compounds.

*(3)* $O^{17}$ and T are present in very small amounts.

. . . Although small in amount, the T content can be determined by radio-activity techniques as a key to the age (and source) of water particularly in underground aquifers.

3 . . Molecular Structure

**a.** Liquids may be non-associated or associated.

*(1)* Non-associated liquids, such as liquid hydrocarbons, have a uniform molecular weight between the melting and boiling point and in the vapor state.

. . . Their properties vary directly with temperature and pressure.

*(2)* Associated liquids contain molecules that are polymerized to form a complex.

. . . Properties do not vary directly with temperature and pressure.

. . . They exhibit an inflection in the temperature-density curves and react abnormally to pressure.

. . . Water, alcohol and ammonia are examples of associated liquids; they are either hydrogen-oxygen or hydrogen-nitrogen combinations.

**b.** Association results from a factor known as hydrogen bonding, wherein a hydrogen nucleus acts as a valence bond by sharing two pairs of electrons with two different atoms when those atoms are oxygen or nitrogen.

*(1)* Thus an associated water molecule would appear as shown in Fig. 1.

*(2)* Buswell has suggested a tetrahedral arrangement (Fig. 2) to explain this association phenomenon, and the formation of dihydrol and trihydrol from the single molecule.

*Dr. Symons is Executive Vice President and Editorial Director of the Scranton Publishing Co., Inc., publishers of *Water & Sewage Works.*

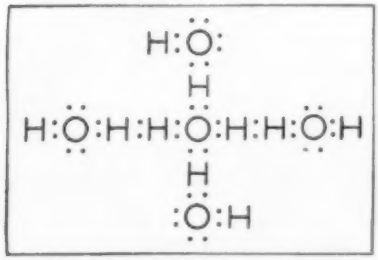
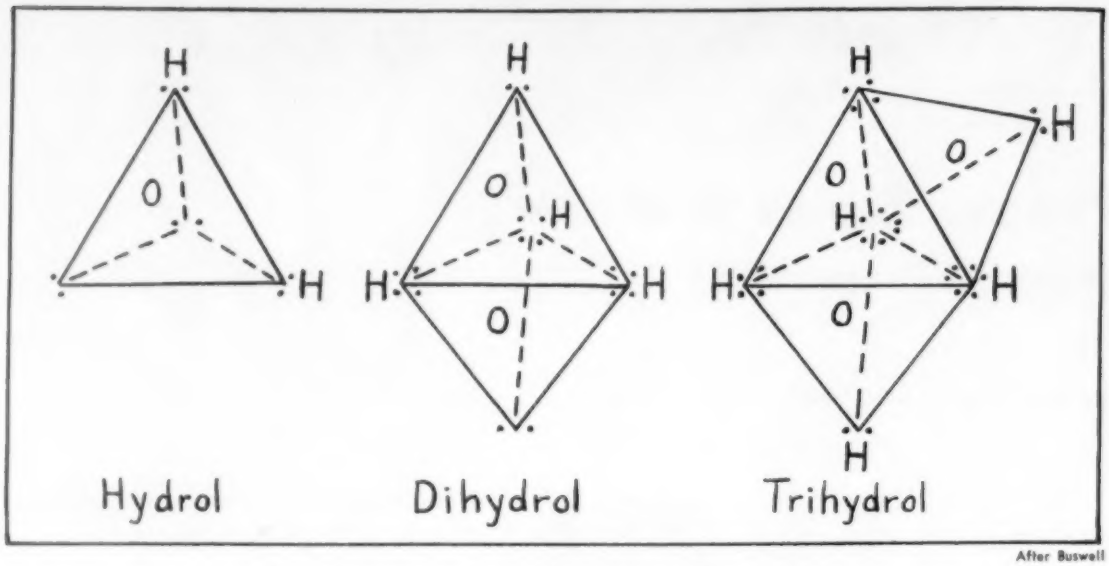


**Fig. 1—ARRANGEMENT of associated water molecules**




After Buswell

**Fig. 2—TETRAHEDRAL arrangement of associated water molecules**

c. These molecular forms exist in equilibrium as

$$2(H_2O)_3 \rightleftarrows (H_2O)_4 \rightleftarrows 6H_2O$$

d. Buswell has estimated the quantitative relationship of these various forms of water to be as follows:

*(1)* at 4°C—mostly $(H_2O)_3$.

*(2)* At 20°C—33 per cent $(H_2O)_3$, 66 per cent $(H_2O)_2$, 1 per cent $H_2O$.

*(3)* At 100°C—1 per cent $(H_2O)_3$, 9 per cent $(H_2O)_2$, 90 per cent $(H_2O)$.

e. Another tetrahedral coordination has been suggested by Bernol and Fowler to explain the apparently flexible net work of molecules which allows for different geometrical patterns and the behavior characteristics of water.

### B . . . Physical Properties

#### 1 . . General

a. Fair & Geyer state that the physical properties important in water works practice are "density, viscosity, vapor pressure, surface tension, resistance to diffusion, power of solution and suspension, absorption of light, heat capacity, and absorption

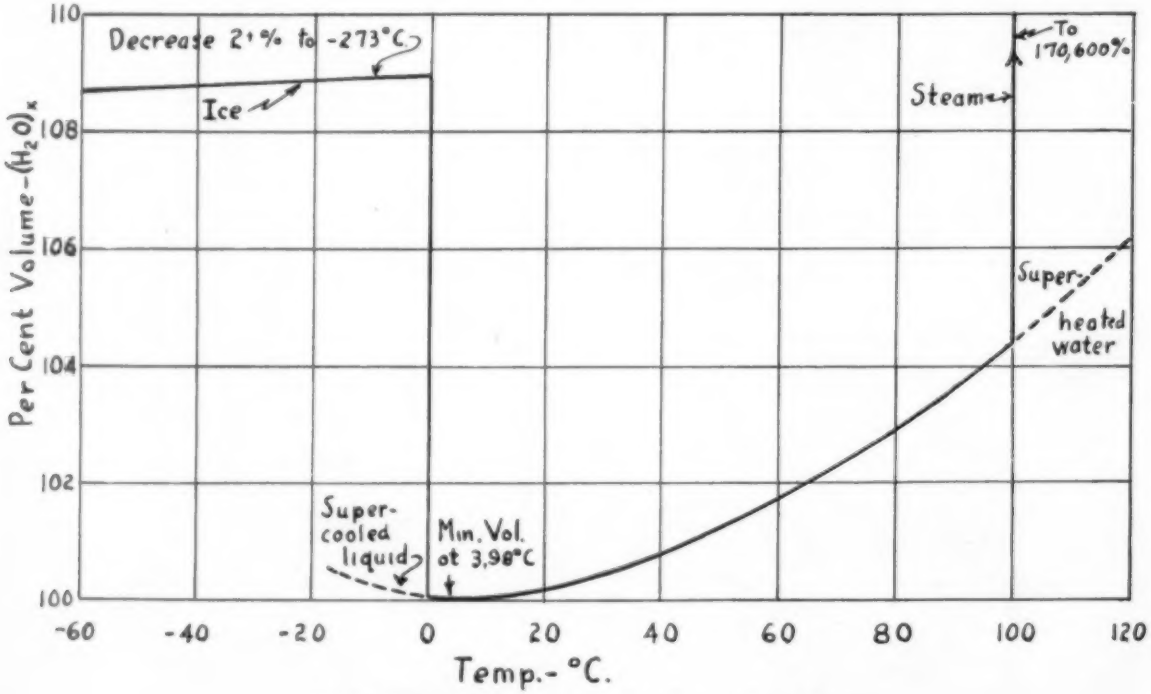



**Fig. 3—TEMPERATURE-volume relation diagram for water**

and transfer of heat".

**b.** Temperature is the greatest single factor which affects the physical as well as the chemical and biological properties of water.

**c.** From the viewpoint of the human senses, water is colorless, tasteless, odorless and wet.

*(1)* Water in small volumes is colorless because it transmits the sun's radiation which the eye can detect (400 to 800 mu mu)

*(2)* Pure water is tasteless because it contains no ionic species in sufficient concentration to excite the taste buds.

. . . To the average observer, "pure" water will taste flat, because he is accustomed to tasting water containing dissolved carbon dioxide, oxygen, nitrogen and usually other chemical compounds in varying degree such as the bicarbonates of calcium and magnesium, etc.

*(3)* Water itself has no odor since its molecules do not excite the olfactory nerve.

*(4)* Water feels wet to man because it has a capillary attraction for surfaces and becomes attached thereto in a film.

. . . Wetted skin surfaces feel cool because heat is withdrawn from the body to evaporate the water adhering to the skin.

### 2 . . Temperature—Volume Relation

**a.** Figure 2 shows the unusual relation of water volume to temperature.

**b.** This strange diagram results from the change in the molecular polymerization and geometrical configuration of water.

*(1)* Strong association near 4°C accounts for the decrease in volume due to the formation of "closely packed" water molecules.

*(2)* The increase from 4°C to 100C° results from the change to less associated molecules as "spreading" of the complex occurs.

. . . The increase below 4°, likewise is due to a change in the geometric arrangement of the polymerized water molecules.

### 3 . . Physical Constants

**a.** Table 1 shows the basic constants for various physical properties of water.

**b.** The importance of temperature to many of these properties is evident from the data in the table.

**c.** The presence of dissolved or suspended substances in water will change several physical constants depending on the concentration of those substances.

*(1)* Dissolved matter will increase the density of a liquid, raise its boil-

## TABLE 1
### Physical Constants of Water

| Property | Condition | Constant |
|---|---|---|
| Boiling Point—Sea level | 760 mm Hg (14.7 psi) | 100°C (212 °F) |
| —5000 ft. | (12.3 psi) | 95°C (203.1°F) |
| —10,000 ft. | ( 9.95 psi) | 89.9°C (193.9°F) |
| Compressibility | | $5 \times 10^{-5}$ per atmos. |
| Density —solid (Ice) | 0°C | 0.918 gm/ml |
| —liquid | 0°C | 0.99987 gm/ml |
| | 3.98°C | 1.0000 gm/ml |
| | 10.0°C | 0.99973 gm/ml |
| | 15.0°C | 0.99913 gm/ml |
| | 20.0°C | 0.99823 gm/ml |
| | 25.0°C | 0.99707 gm/ml |
| | 30.0°C | 0.99567 gm/ml |
| | 100.0°C | 0.95838 gm/ml |
| Diffusion Coefficient into air | | 0.193 |
| Electrical conductivity | | $4 \times 10^{-8}$ mhos/cm |
| Dielectric constant | | 81.5 |
| Freezing point | 760 mm Hg (14.7 psi) | 0.0°C (32°F) |
| | 1520 mm Hg (29.4 psi) | −0.0075°C |
| Heat Conductivity | 32°F | 0.34 Btu/(hr)(sq ft)(°F per ft) |
| | 212°F | 0.42 Btu/(hr)(sq ft)(°F per ft) |
| Heat of Fusion | 760 mm Hg | 79.6 cal/gm |
| | | 143. Btu/lb |
| Heat of Vaporization | 760 mm Hg | 542 cal/gm |
| | | 970 Btu/lb |
| Light Absorption—Coefficient of extinction $K_e$ per ft. | Red—7200 Angstrom Units | $3.2 \times 10^{-1}$ |
| | Orange—6125 Angstrom Units | $7.7 \times 10^{-2}$ |
| | Yellow—5650 Angstrom Units | $1.3 \times 10^{-2}$ |
| | Green—5040 Angstrom Units | $3.1 \times 10^{-3}$ |
| | Blue—4730 Angstrom Units | $1.6 \times 10^{-3}$ |
| | Violet—4078 Angstrom Units | $3.1 \times 10^{-3}$ |
| Surface Tension | 0°C | 75.6 dynes/cm |
| | 5°C | 74.9 dynes/cm |
| | 10°C | 74.2 dynes/cm |
| | 15°C | 73.5 dynes/cm |
| | 20°C | 72.8 dynes/cm |
| | 25°C | 72.0 dynes/cm |
| | 30°C | 71.2 dynes/cm |
| Vapor Pressure | 0°C | 4.58 mm Hg |
| | 5°C | 6.54 mm Hg |
| | 10°C | 9.21 mm Hg |
| | 15°C | 12.8 mm Hg |
| | 20°C | 17.5 mm Hg |
| | 25°C | 23.8 mm Hg |
| | 30°C | 31.8 mm Hg |
| | 50°C | 97.5 mm Hg |
| | 70°C | 233.7 mm Hg |
| | 90°C | 525.8 mm Hg |
| | 100°C | 760.0 mm Hg |
| Viscosity | 0°C | 1.792 centistokes |
| | 5°C | 1.519 centistokes |
| | 10°C | 1.310 centistokes |
| | 15°C | 1.145 centistokes |
| | 20°C | 1.011 centistokes |
| | 25°C | 0.8975 centistokes |
| | 30°C | 0.8039 centistokes |
| | 50°C | 0.5494 centistokes |
| | 100°C | 0.2838 centistokes |

ing point, lower its freezing point and decrease it compressibility.

*(2)* Dissolved matter may or may not lower the viscosity of water depending on the substance, but generally will lower the vapor pressure.

*(3)* Dissolved matter will increase the electrical conductivity of water if these substances ionize; inert gases have no effect on conductivity.

*(4)* Suspended matter, especially if finely divided or gelatinous (hydrous) in nature will increase the apparent density of water carrying these substances.

4 . . Hydraulic Properties

**a.** Compressibility, density and viscosity are the most important physical properties in relation to the transportation, distribution and measurement of flow of water.

**b.** The practically imcompressible nature of water has an important bearing on the pumping and measurement of water and the distribution thereof.

*(1)* Designs and operation of pumps and flow meters are affected by the factor of compressibility.

*(2)* The volume of water discharged from a system is the same as that introduced regardless of the loss of pressure due to friction between the two points. This continuity of quantity is important in the measurement of flow.

**c.** Density and viscosity affect the hydraulic properties of water, especially where motion of resistance to it are concerned; both appear in the formula for Reynolds Number as it applies to flow; both are important factors in pumping and flow measurement.

**d.** Vapor pressure also affects pumping since it reduces the suction lift of pumps in proportion to this pressure.

5 . . Effects on Storage

**a.** The storage of water is affected by density, particularly in deep bodies of water.

*(1)* Variations in the density of water in deep lakes cause seasonal stratifications and overturning.

*(2)* Water has its greatest density at a temperature above its freezing point. This fact, coupled with the fact that wind and wave action ordinarily does not extend deeper than 50 feet, causes seasonal cycles of changes, which affect the quality of water in deep lakes.

*(3)* "Inverse stratification" exists in winter.

. . . The colder water at 0°C is on top.

. . . Warmer water at 4°C is below because it is more dense.

*(4)* "Spring overturning" occurs when ice melts and the surface temperature rises to 4°C when the surface water sinks to the level of that which was 4° during the winter.

. . . As the lake approaches a constant temperature of 4°C throughout its depths, there is no stratification and a wind storm will easily cause a mixing of the layers of the lake or a "spring overturning".

. . . Entrance of spring waters warmer than 4°C at the bottom of the lake will aid in the overturning.

*(5)* "Direct Stratification" exists in summer.

. . . As air temperatures increase so does temperature of the surface layer. The warmer water being less dense remains on top and there exists a temperature gradient down to the level of wind action effects.

*(6)* Below the level of wind and wave effect, the temperature of a lake drops rapidly to 4°C and this temperature prevails to the bottom of the lake.

. . . This level of sudden temperature change in the lake is termed the "thermocline", or "mesolimnion" or "transition zone".

. . . Above the transition zone is the "epilimnion" or zone of circulation; below the transition zone is the "hypoliminion" or zone of stagnation.

*(7)* "Fall overturning" occurs as the surface of water cools to 4°C and sinks to the level of the zone of transition.

. . . As the temperature becomes practically constant at 4°C from top to bottom, winds can stir up the lake and cause a "fall overturning".

*(8)* Periods of stratification and overturning have a marked effect on the quality of water from deep lakes.

. . . Dissolved oxygen, carbon dioxide, carbonate and sometimes the manganese and hydrogen sulfide content as well as the taste and odor of waters change markedly during periods of overturning.

*(9)* In deep lakes the placement of a water intake in the zone of transition assures a relatively cool water supply.

**b.** Evaporation of water from the surface of storage reservoirs, lakes and rivers depends on two physical properties of water, its vapor pressure and its diffusion constant into air, as well as several other physical factors.

*(1)* The higher the temperature, the greater the rate of evaporation because of the higher vapor pressure.

*(2)* Air in contact with water soon becomes saturated with water because of the low diffusion rate into air and the relatively low capacity of air to hold moisture.

. . . Therefore evaporation is enhanced by movement of air over the surface of the water; i.e. the exposure of more air volume to the surface.

. . . Evaporation rates therefore increase with increases in both temperature and wind velocity.

*(3)* Other factors which affect evaporation include surface area, humidity and barometric pressure.

. . . In still, circular areas evaporation is proportional to the square root of the surface area.

. . . The greater the humidity, that is the more saturated the air, the slower the rate of evaporation and the lower the barometric pressure the higher the rate of evaporation.

**c.** Solution and diffusion characteristics affect the quality of water in storage.

*(1)* Water has the ability to dissolve both gases and solids with which it comes in contact.

*(2)* The solubility of gases, or the amount that water will dissolve, depends directly on the partial pressure of the gas in contact with the liquid surface and inversely on the temperature of the water.

. . . The rate at which gases will be absorbed depends on and is proportional to the degree of undersaturation (See Lecture on Aeration).

*(3)* The solubility or amount of chemical substance, not gases, which water will hold depends on temperature of the water, nature of the substance, its ionizability, and the presence of other chemicals.

*(4)* Diffusion or the tendency of dissolved ions and molecules to migrate through water is a very slow process which depends on temperature.

. . . Given time and ideal conditions diffusion will cause a complete mixing and distribution of dissolved matter throughout a body of water, except as it may be overcome by density current effects.

. . . Practically speaking, mechanical mixing by wind and wave action is far more important in the solution and distribution of dissolved matter in water supplies.

6 . . Treatment Effects

**a.** Density, viscosity, ability to dissolve, and temperature of water all have an effect on the treatment of water.

**b.** Density currents resulting either from temperature or from a content of dissolved or suspended solids may create short circuiting in settling tanks (or larger bodies of water).

**c.** Viscosity plays an important part in floculation, sedimentation of

particles and the filtration of water through sand.

**d.** Ability to dissolve or precipitate gases and solids has a definite bearing on aeration, flocculation, softening, (and even on filtration, since both dissolved gases and solids may under certain conditions be subject to desolution in rapid sand filters).

7 . . HEAT AND LIGHT

**a.** Water has an ability to absorb heat.

*(1)* Heat capacity is the amount of heat required to raise a unit mass one degree in temperature.

*(2)* Specific heat is the ratio of heat capacity at a given temperature to that of water at a standard temperature.

. . . For most purposes, heat capacity and specific heat are numerically equal.

*(3)* The unit of measurement of heat capacity is either calorie per gram per degree Centigrade or Btu per pound per degree Fahrenheit.—Numerically these units are the same.

. . . Heat capacity varies little with temperature.

. . . The specific heat of ice is half that of water.

*(4)* Heat of fusion is the amount of heat (cal/gm or Btu/lb) that must be added to solid water (ice) to convert it to liquid water. Heat of vaporization is the amount of heat necessary to convert liquid water to gaseous water (steam).

Heats of fusion and of vaporization (Table 1) are high when compared to other substances.

**b.** Water conducts heat very slowly in the absence of motion and transfer by conduction through other substances.

*(1)* Cooling of the surface by evaporation causes the surface layer to become more dense and sink and thus set up convection currents which will transfer heat within the liquid.

*(2)* Currents induced by wind action in reservoirs are effective in transferring heat within the body of water.

**c.** Light absorption is relatively small in the visible spectrum range.

*(1)* Large bodies of water appear blue because red and infra red rays are absorbed while blue and ultraviolet rays pass.

*(2)* The blue color is composed of (a) polarized light reflected from the surface and (b) reflected from particles.

. . . Yellow and red radiation is absorbed in proportion to depth of the liquid.

*(3)* Dissolved substances have no affect on color unless colored themselves.

*(4)* The fact that ultraviolet rays are not absorbed makes it possible to use this wave length for disinfection.

8 . . ICE FORMATION

**a.** Although water normally freezes at 0°C, it can be super-cooled to as low as −12 to −15°C before ice formation begins.

*(1)* The liquid must be quiescent and free of colloidal nuclei.

*(2)* When ice formation begins in supercooled water, the whole mass congeals rapidly.

**b.** Ice crystalizes in prisms or plates of the hexagonal system.

*(1)* Seldom are individual crystals found.

*(2)* When pure it is clear and of a bluish color.

**c.** The density of ice (0.918 at 0°C) is near but less than that of water, which explains why ice floats and also why approximately 92 per cent of an iceberg is below water.

**d.** The volume of ice decreases and the density increases only 2 per cent as ice is cooled to absolute zero (−273°C)—See Fig. 3.

**e.** Anchor ice which forms at the bottom of swiftly moving streams is not heavier than water; it is simply ice attached to the stream bed which is colder than the water.

**f.** There are forms of ice heavier than water but these are produced only when the water is under enormous pressure.

*(To be continued)*

## Legislative Control in Radioactive Waste Disposal

The U. S. Department of Commerce has recently released Handbook No. 61, of the National Bureau of Standards entitled "Regulation of Radiation Exposure by Legislative Means."* It comprises a report of the National Committee on Radiation Protection and deals with the problem of atomic radiation in relation to its possible control by state or municipal authorities.

The need for effective and uniform state legislation is illustrated by reference to the type of radiation control undertaken by states up to the present time. Only four states have made any major effort in this respect and, already, uniformity is lacking. In addition there will be the almost certain federal licensing of AEC-produced radioisotopes. Confusion is well on its way.

The philosophy expressed is that a radiation-control act should be as simple as possible and enforcable, with details left to the regulations. Enforced registration of every use of radiation is the minimum control recommended in the report. It is felt that compulsory registration can accomplish as much as licensing and does not involve the same degree of complexity.

The shortage of trained control personnel will be a problem for many years. Since few states will be able to attract into full-time service the experienced experts whose guiding influence in radiation control is essential to the success of a radiation control program it is recommended that the best experts available be used in a consultative capacity. An advisory body of radiation-protection experts should be made an integral part of any legislative plan at whatever level.

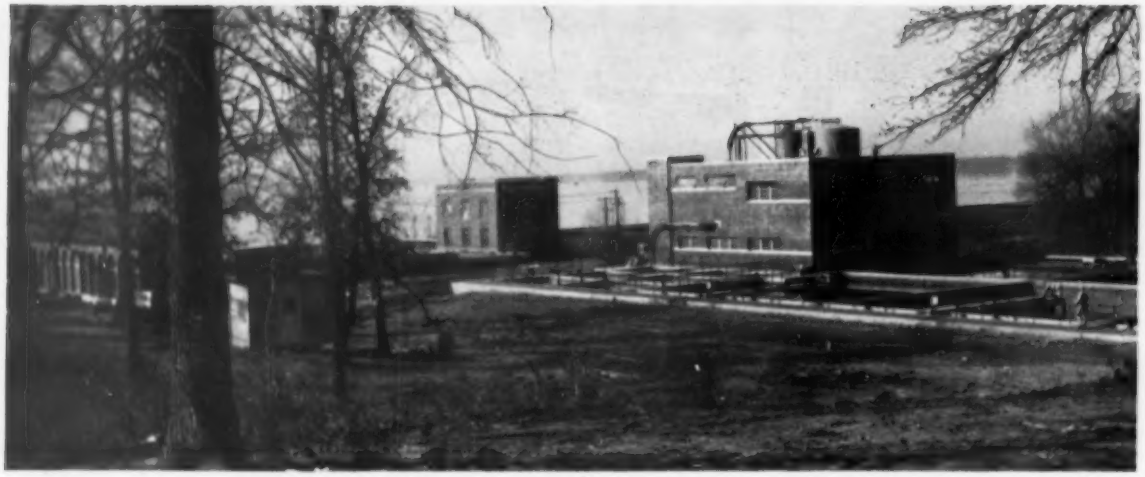
Control of the disposal of radioactive wastes is dealt with under Section 14 of the suggested regulations. Because it is impractical or impossible at the present time to formulate detailed waste-disposal regulations that will provide adequate safety under all conditions, without being unnecessarily restrictive under most conditions, only a few broad rules applicable to cases of most common interest are stated. It is emphasized that in the disposal of radioactive wastes, once a disposal event has taken place all further control over the material usually is completely out of the hands of the disposer and an irreversible train of events will have begun. Because of this, it is essential that special care and consideration be exercised before any disposal operation is approved or commenced.

The suggested regulation specifies that users of radioactive materials shall release these materials in such a manner that the radioactive material discharged, in combination with that discharged by other users, will not cause contamination of the environment, a waterway for the ground-water table that may result in persons receiving an excessive dose.

The limits of radioactivity in water, resulting from disposal of radioactive wastes, and the methods for their determination are given in the report. Disposal of radioactive wastes by dumping and burial would be allowed only in areas approved by the control agency.

Technical standards, guides and general information necessary to achieve the requirements of the suggested regulations are also given in the Bureau of Standards Handbook No. 61*.

*Available from the Supt. of Documents, Gov't. Printing Office, Washington 25, D. C. for 0.25/copy.



CROSS LAKE PLANT—Built in 1930, enlarged in 1947, 1952 and 1956

# How To Reduce Operating Costs At Water Treatment Plants—I*

**by A. A. HIRSCH**

**Mr. Hirsch is Water Purification Superintendent, Dept. of Water and Sewerage, Shreveport, La. In this article he reviews the case history of the Shreveport water plants and how they reduced operating costs.**

IN A PAPER given by the writer before this Conference three years ago on the identical subject as set for this panel, the various items of cost in water plant operation were classified and prospective steps for their reduction were outlined in general terms. During the interim a few new materials and methods have become available, but the principles presented then are equally as applicable to-day. Rather than repeating the analysis of costs and enumerating the fundamental techniques for their reduction, this discussion will be limited to an operational case history of the Shreveport water plants.

### Procurement of Raw Water

During the intensive drought of 1954 means were sought to relieve the diminishing water supply in Cross Lake by stimulating rainfall by artificially seeding clouds with silver iodide vapor. Two months after the project was initiated water overflowed the spillway, and a short time later, during the spring rains, the lake level reached a record height. Compared to the cost of developing supplemental supplies, or for providing reservoir sites for storage of run-off, the funds allocated to cloud seeding netted handsome returns. The Shreveport experience is paralleled by other successful cloud seeding ventures in the Southwest United States and over the globe.

Pertinent to the topic of impounded water resources, this Conference should note a project of tremendous significance being organized by the Southwest Research Institute for the study of evaporation control from reservoirs. A thin film, only 1/10,000,000 of an inch thick, of certain chemicals, such as hexadecanol, covering the surface of a body of water is stated to be sufficient to reduce the rate of evaporation at an estimated cost of ¼ cent to 2½ cents per thousand gallons of water conserved.

### Chemicals for Treatment

Chemicals are purchased on a bid basis by annual contract using AWWA quality specifications to which further features, desirable for our own particular case, have been added.

At the Cross Lake Plant alum is received in hopper bottom carloads and is emptied by a pneumatic conveyor into storage bins directly over the scale hopper of a loss-in-weight type of feeder. Lime will be handled by this means also as soon as facilities are installed under the current construction program. Arrangement to receive chlorine in single unit tank car shipments is expected to be provided in the near future.

At the McNeil Street Plant chemicals in bags are unloaded from freight cars on the plant spur immediately beside the building to a belt conveyor which elevates the material to the storage room. Wastage from

* A paper presented as part of a panel on the subject of "Ways of Reducing Water Plant Operating Costs" held at the Nineteenth Annual Short Course for Water and Sewage Plant Superintendents and operators at Louisiana State University. Published here by permission. Also see companion paper by J. L. Love in this issue.

damage to bags is minimized by specifying acceptable construction of the paper sacks, and by eliminating all sharp edges and points on the elevator guide rails and on dollies used to wheel the bags to stock piles.

A frequent source of loss of lime at both plants has been caused by arching in the feed hopper and then flooding when the unsupported vertical build-up lining the wall collapsed. The result besides being wasteful, was also untidy and troublesome to clean up. Flooding has been overcome completely by installing electromagnetic vibrators near the bottom of the feed hoppers.

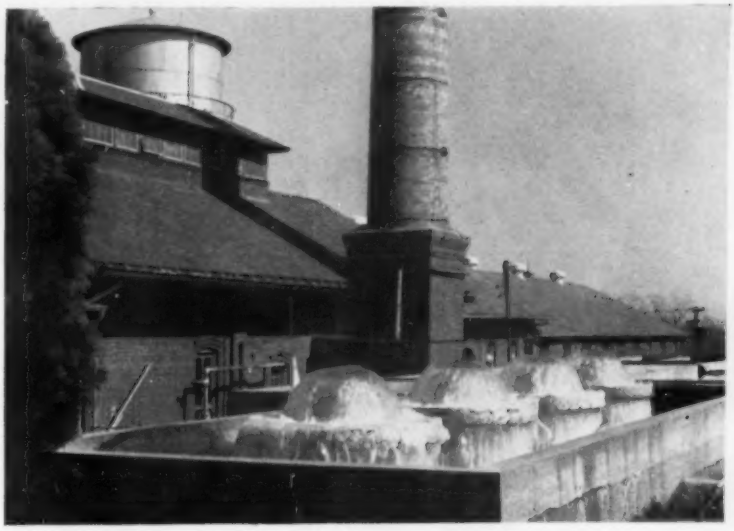
### Application of Chemicals

Since Shreveport water is supplied from a surface source, the amount of chemical feed varies with character of the water and with rate of flow. The chemical demand is determined by periodical tests in the laboratory and by check tests made by the operators. At the Cross Lake Plant a continuous 3-station strip recorder monitors the pH of raw water, filter influent and tap samples.

At the McNeil Street Plant a unique metering device has been developed to measure the rate of influent raw water pumpage and is being adapted to pace the coagulant feed. It consists of a head tube mounted in the pipeline leading to the aerator manifold. This is the only point in the piping where the flow is undivided. Since to the low lift pumps draw down the level of the receiving well from the lake, air is almost invariably discharged in the water, thereby complicating any other system of measurement. Careful calibration has uncovered some unexpected linear characteristics which further simplify application to chemical feeder motors.

Points of application of alum and of lime are widely separated so that each can perform its separate function without mutual interference.

At the Cross Lake Plant the feed solution troughs were originally constructed to dump into the jump of the Parshall flume. This has been improved by straddling a saw-tooth weir across the width of the jump to attain better distribution of alum. A further improvement will be installed when the present construction program is finished, by feeding alum in the riser in advance of the Parshall flume. Experiments have demonstrated a much superior flocculation than when chemical is added conventionally at the throat.



**McNEIL STREET PLANT—Aerators and original building**

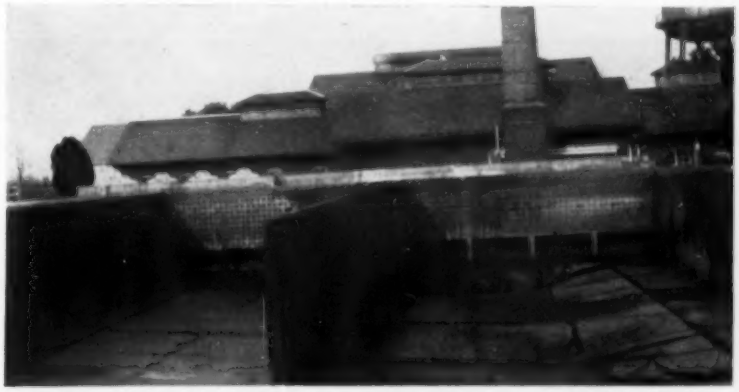
Built in 1888, this plant is the oldest in Louisiana and one of the few steam plants in the south

### Quick Mix Units

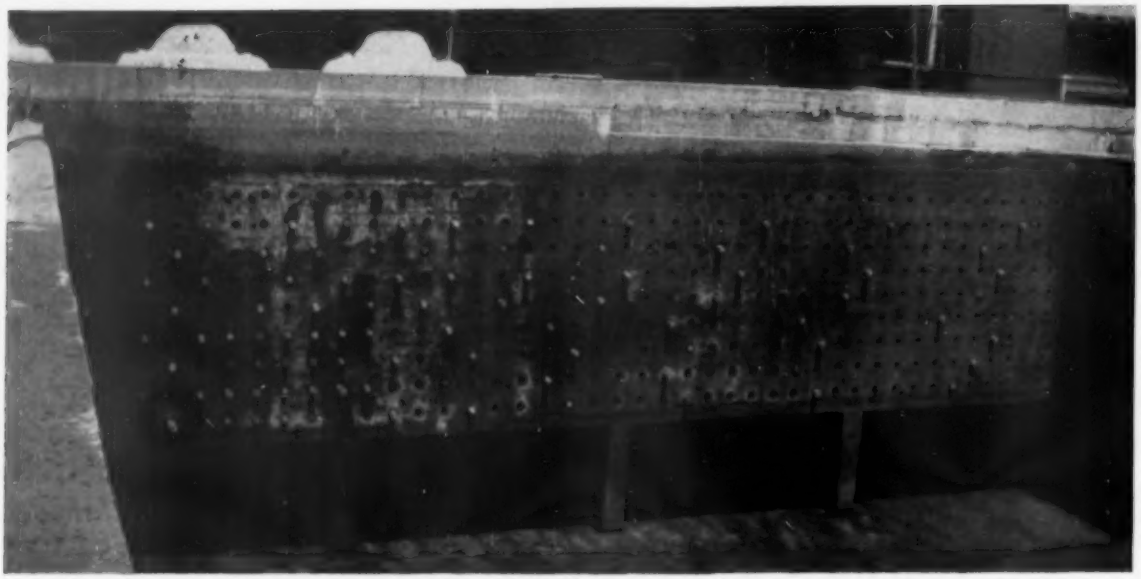
The original equipment at the Cross Lake Plant included mechanically stirred quick mix chambers between the Parshall flume and the flocculators. These quick mixers had been left idle for some years due to their apparent lack of value and their power consumption. However, it was decided to test their performance. varying conditions insofar as possible in search of some circumstances where they might be useful. Accordingly, blade size and position were varied, also vertical fins were installed in the middle of all side walls. Unfortunately, speed of rotation could not be varied as this would have entailed purchase of new motors. As a final result, while some improvements were effected the plant still operated better without the quick mixers. The mixing function in our case is completely provided in the Parshall flume. New units in our plant extension omit quick mix basins entirely.

### Flocculation

The Cross Lake Plant provided unusual opportunities to study and apply the experimental method for establishing optimum conditions for operation of a flocculation basin. Originally the flocculator paddles were structually deficient; every time a unit was drained for washing and inspection at least one of the agitators had to be welded back on its mounting. This situation was corrected and improved by adding another set of agitators on heavier framework, and tying the whole assembly with stressed rods. Not a sin-



**SETTLING BASIN, McNeil St.—Note division wall (around-the-end baffle) and inlet and outlet orifice walls**



**PULPWOOD PLUGS selectively placed to avoid short circuiting of flow and jet action flow into effluent pipe on other side of wall—McNeil St. Plant**

gle structural failure has occurred since this reinforcement.

Flow conditions across the effluent weirs from the flocculators were checked by means of a midget flow meter and the influent sluices to the second basin throttled to equalize distribution. It was found that in the unregulated, wide open condition the second unit would flow more than twice the amount of water as in the first unit.

Considerable investigation on the relation of paddle speed, number of paddles in use and efficiency of floc growth developed the optimum conditions for building up floc size and coherence. Although the customary cautious words "in our particular case" should ordinarily be added to qualify these remarks, the writer believes that the findings at Shreveport apply qualitatively at least to functionally similar flocculation basins.

The end result was that all paddles were discarded but the first, and these were rotated at a speed considerably slower than mechanically provided for originally. Natural hydraulic currents also are important in providing for floc growth. Results of this study have been incorporated in the design of the new flocculating units in the present plant expansion.

## Coagulating Reservoirs

Possibly one of the most important single items in economizing operation is the management of sedimentation. Any move to apply good chemical and hydraulic principles is a lucrative source of financial returns.

At the McNeil Street Plant, inlet and outlet flow patterns of the basins is controlled by orifice walls, containing about 400 3½ inch holes in each section of basin. In order to forestall jet action at inlets and outlets, some 100 of the holes adjacent thereto in each wall have been plugged with pulpwood cylinders so as to distribute the flow areally.

As a first approach to the selection of which holes to plug, the principle was assumed, that flow across any portion of the orifice wall was inversely proportional to the distance from the concentrated inlet or outlet. In practice this amounts to a pattern where the ports are closed singly after open reaches of holes (1, 2, 3, 4, etc.) in series radiating from inlet or outlet. An even disposition of sludge across the width of the basins has demonstrated the value of this move.

A project is now in progress for rerouting the course of the water through the basins so as to obtain slower velocities, conserve head losses, and permit automatic control of liming based on flow measurement from incidental friction drop across the point of application.

At the Cross Lake Plant a series of vertical baffles placed under the central skimmer walls with the purpose of reducing thermal currents were removed because they were found to be a source of avoidable turbulence and floc resuspension. Other conditions have been improved in one of the basins as a demonstration preparatory to extending the changes to the other three existing basins. Curbing around the edges of the clarifier rake was removed to re-

**SETTLING BASIN, Cross Lake—Note driving heads of clarifiers and advanced position of draw-off weir in nearest basin.**

195 CITY OF SHREVEPORT, LOUISIANA DEPARTMENT OF WATER & SEWERAGE 195

WATER PURIFICATION DIVISION ANNUAL REPORT

| MONTH | JANUARY | | FEBRUARY | | NOVEMBER | | DECEMBER | | AVERAGE | | | MAXIMUM | | | MINIMUM | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PLANT | Mc NEIL ST | CROSS LAKE | Mc NEIL ST | CROSS LAKE | Mc NEIL ST | CROSS LAKE | Mc NEIL ST | CROSS LAKE | Mc NEIL ST | CROSS LAKE | BOTH PLANTS | Mc NEIL ST | CROSS LAKE | BOTH PLANTS | Mc NEIL ST | CROSS LAKE | BOTH PLANTS | Mc NEIL ST | CROSS LAKE | BOTH PLANTS |
| FILTERED WATER PUMPED TOTAL MG | | | | | | | | | | | | | | | | | | | | |
| DAILY AVG. M G D | | | | | | | | | | | | | | | | | | | | |
| DAILY MAX. M G D | | | | | | | | | | | | | | | | | | | | |
| DAILY MIN. M G D | | | | | | | | | | | | | | | | | | | | |
| HOURLY MAX M G D | | | | | | | | | | | | | | | | | | | | |
| HOURLY MIN. M G D | | | | | | | | | | | | | | | | | | | | |
| HOURS PLANT OPERATED DAILY | | | | | | | | | | | | | | | | | | | | |
| AVG. TEMPERATURE F° TAP | | | | | | | | | | | | | | | | | | | | |
| TOTAL RAINFALL INCHES | | | | | | | | | | | | | | | | | | | | |
| LAKE STAGES M.R.D. MAX.–MIN | | | | | | | | | | | | | | | | | | | | |
| TURBIDITY PPM RAW | | | | | | | | | | | | | | | | | | | | |
| COLOR PPM RAW | | | | | | | | | | | | | | | | | | | | |
| pH RAW | | | | | | | | | | | | | | | | | | | | |
| pH SETTLED | | | | | | | | | | | | | | | | | | | | |
| pH TAP | | | | | | | | | | | | | | | | | | | | |
| PHENOL. ALKALINITY PPM RAW | | | | | | | | | | | | | | | | | | | | |
| PHENOL. ALKALINITY PPM TAP | | | | | | | | | | | | | | | | | | | | |
| TOTAL ALKALINITY PPM RAW | | | | | | | | | | | | | | | | | | | | |
| TOTAL ALKALINITY PPM TAP | | | | | | | | | | | | | | | | | | | | |
| TOTAL HARDNESS PPM RAW | | | | | | | | | | | | | | | | | | | | |
| TOTAL HARDNESS PPM TAP | | | | | | | | | | | | | | | | | | | | |
| TOTAL DISSOLVED SOLIDS PPM RAW | | | | | | | | | | | | | | | | | | | | |
| TOTAL DISSOLVED SOLIDS PPM TAP | | | | | | | | | | | | | | | | | | | | |
| THRESHOLD ODOR (test) RAW | | | | | | | | | | | | | | | | | | | | |
| THRESHOLD ODOR (test) SETTLED | | | | | | | | | | | | | | | | | | | | |
| THRESHOLD ODOR (test) FILTER EFF. | | | | | | | | | | | | | | | | | | | | |
| THRESHOLD ODOR (test) TAP | | | | | | | | | | | | | | | | | | | | |
| CHLORINE RESIDUALS PPM RAW | | | | | | | | | | | | | | | | | | | | |
| CHLORINE RESIDUALS PPM SETTLED | | | | | | | | | | | | | | | | | | | | |
| CHLORINE RESIDUALS PPM TAP | | | | | | | | | | | | | | | | | | | | |
| COLIFORM BACTERIA M P N per 100 ml. LAKE | | | | | | | | | | | | | | | | | | | | |
| COLIFORM BACTERIA M P N per 100 ml. RAW(CL) | | | | | | | | | | | | | | | | | | | | |
| AVG. NO. FILTERS WASHED DAILY | | | | | | | | | | | | | | | | | | | | |
| AVG. LENGTH FILTERS RUN HOURS | | | | | | | | | | | | | | | | | | | | |
| WASH WATER % | | | | | | | | | | | | | | | | | | | | |
| CHEMICALS USED POUNDS ALUM | | | | | | | | | | | | | | | | | | | | |
| CHEMICALS USED POUNDS LIME | | | | | | | | | | | | | | | | | | | | |
| CHEMICALS USED POUNDS CHLORINE | | | | | | | | | | | | | | | | | | | | |
| AVG. DOSAGE ALUM GPG | | | | | | | | | | | | | | | | | | | | |
| AVG. DOSAGE LIME GPG | | | | | | | | | | | | | | | | | | | | |
| AVG. DOSAGE CHLORINE PPM | | | | | | | | | | | | | | | | | | | | |
| CHEMICAL COSTS DOLLARS ALUM | | | | | | | | | | | | | | | | | | | | |
| CHEMICAL COSTS DOLLARS LIME | | | | | | | | | | | | | | | | | | | | |
| CHEMICAL COSTS DOLLARS CHLORINE | | | | | | | | | | | | | | | | | | | | |
| CHEMICAL COSTS DOLLARS TOTAL | | | | | | | | | | | | | | | | | | | | |
| CHEMICAL COSTS DOLLARS BOTH PLANTS | | | | | | | | | | | | | | | | | | | | |
| UNIT CHEMICAL COST DOLLARS per M G ALUM | | | | | | | | | | | | | | | | | | | | |
| UNIT CHEMICAL COST DOLLARS per M G LIME | | | | | | | | | | | | | | | | | | | | |
| UNIT CHEMICAL COST DOLLARS per M G CHLORINE | | | | | | | | | | | | | | | | | | | | |
| UNIT CHEMICAL COST DOLLARS per M G TOTAL | | | | | | | | | | | | | | | | | | | | |
| UNIT CHEMICAL COST DOLLARS per M G BOTH PLANTS | | | | | | | | | | | | | | | | | | | | |

**ANNUAL SUMMARY of treatment operations and costs**

Ed Note: The full report measures 34 x 20 inches and contains all 12 months.

duce turbulence where it passed under a deep skimmer wall, and also to allow mud movement to an area within reach of the rake.

A swing end at the tip of the rake has been tied out of operation as it would now move wildly without a curb, and it was considered an unnecessary appendage of value to sewage plants only. The effluent weir in the experimental basin has been advanced toward the entrance end to reduce the chimney-like uptake of floc where drawn off. These points have been utilized in the design of the new basins now about to be installed. In addition, the influent and effluent ends will have orifice walls, as at the McNeil Street Plant, and the flocculator will be located directly abutting the influent end.

Wastage of treated water in the process of mechanical desludging is minimized by calibrating the drain valves to discharge a thick slurry at a time rate matching that of deposition. On each shift, the sewer is flushed out to avoid the possibility of clogging.

## Filter Operation

Economy in filter management is accomplished, insofar as possible, by holding the rate setting as low as production requirements will permit. This makes for long runs and reduces wash water consumption. Efficiency of wash has been found related to losses in head during reverse flow and the washing procedure has been established accordingly at the Cross Lake Plant.

## Miscellaneous

Alert plant operation presupposes the proficient use of laboratory and operational controls to the fullest extent applicable. Some of the newer additions to the inventory of the Shreveport laboratory include a stainless steel assembly for membrane filter bacteriology and a photoelectric colorimeter. A conductivity bridge to fit our special needs for both laboratory use and for field surveys is on order.

A system of records is maintained for control of operations, for calculation of costs, and for preparation of

a monthly summary report to official heads and the State Department of Health. From the principal data on this record is compiled an annual report sheet which permits concise reference to past conditions and performances. Our annual report is exchanged with other water plants for comparative study and incentive. A copy of the report form is shown in an accompanying illustration.

In conclusion, on-the-beam type of water plant operation is a worthy *engineering* function; as such it is amenable to economies in costs and upgrading in quality of product when purposefully studied.

RAPID treatment unit; aerator left; No. 5 well in rear

# How To Reduce Operating Costs At Water Treatment Plants—II*

**by J. L. LOVE**

**Mr. Love is Superintendent of Water and Sewerage in Lafayette, Louisiana. In this paper he describes several procedures used at his plant to effect a reduction in operating costs.**

IMPROVED administrative practices have enabled our water utility to give good service, and a better quality of water, without raising rates since 1949. This has been accomplished primarily by changes in the water treatment plant operations. In 1948 there was no uniform system of accounting, no plant production records, nor were there any daily or monthly plant operating logs. The only record that was kept was the water quality report as required by the State Health Department.

In 1949, we adopted and put in practice the uniform system of accounts for water utilities, as prepared by the National Association of Railroad and Utilities Commissioners. This system has continued to be helpful. By giving each department head a copy of the monthly financial and operating statement, he can assist in keeping his operating expenses within the adopted budget. Production records have also been set up as well as daily and monthly plant operating logs.

## Plant Improvements and Additions

In 1952, we were able to make needed improvements and additions to our water treatment plant. These improvements included a rapid treatment unit, hydraulic elevator for handling chemicals, proportional chemical feeders, and proportional sludge draw-off units. New pressure and flow instruments were installed on a central control panel, which gives complete plant control from one point. Pneumatic instruments were installed on the new filters. Also, pneumatic level indicators were installed on the storage reservoirs and the high service pumping reservoirs and a complete chemical and bacteriological laboratory was set up.

One of the first things checked

* A paper presented as part of a panel on the subject of "Ways of Reducing Water Plant Operating Costs" held at the Nineteenth Annual Short Course for Water and Sewage Plant Superintendents and operators at Louisiana State University. Published here by permission. Also see companion paper by A. A. Hirsch in this issue.

after I took over this plant in 1951 was the analysis of the lime. This analysis showed that an inferior grade of hydrated lime was being bought and a premium price was being paid—the calcium oxide content was 62 per cent and the silica content was 16 per cent. In other words, sand was being bought. Lime suppliers were immediately changed and analysis showed the new lime to have a 73 per cent calcium oxide content. Periodic analysis on the lime are made assuring us lime of top quality.

Settleability tests are also made on each carload of lime. The better quality of lime plus other improvements in treament control has resulted in a reduction in lime use from 8.2 grains per gal. to 4.9 grains per gal., a decrease of 40 per cent. This improvement was achieved in spite of the fact that the water from one of the new wells is two grains harder than water from previous wells. A periodic analysis is also made of the aluminum sulphate that is used.

In addition to reduced lime usage, the coagulant dosage in our treatment has been reduced by 29 per cent. How was this done? The answer is—the proportional controls; rigid laboratory control; teaching the operators to use these controls; having the operators run hourly hardness, pH, and chlorine residual tests; and finally by the purchase and use of an electronic pH meter and an electronic stop colorimeter. Sending our operators to District Operational Schools, and to the annual State Short School has helped greatly in improving operation.

The results of these improvements are shown in the following data compiled from our financial and operating statement: In May 1952 production cost was $0.0535 per thousand gallons of water treated. In May 1955 production cost was $0.0525 per thousand gallons of water treated. In this same period there was a salary increase of 29 per cent with the same number of operating personnel, and a production increase of 24 per cent. There was also a price increase of 9 per cent for lime, 16 per cent for alum, 7 per cent for chlorine, and a 3.5 per cent for sodium hexameta phosphate.

Improvements were made in the aeration process which resulted in a 20 per cent increase in $CO_2$ removal, which in turn reduced the amount of lime required. Improvements were also made in well design and operation. It was found that the well turbines' characteristics varied as much as 90 ft in total pumping head. The most desirable pump characteristics were worked out and as the pumps were pulled for inspection the impellers were changed.

**SAFETY meeting—In summer, held on the lawn, under moss covered trees**

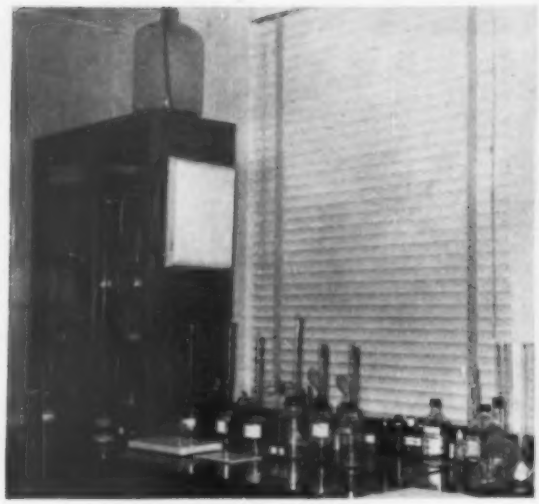
After finding that the aquifer has gravel of sufficient size for development into a natural gravel wall the design of the new well was also changed. A screen with openings large enough to let the sand through is now used, in order that it can be pumped out during the initial development. It was also found that the high service pump characteristics varied as much as 36 ft in total pumping head. Some of these pumps have been removed from service, and others have had the impellers altered. These improvements reduced power costs by 30.5 per cent from 1951 to 1952.

### Maintenance Program

Realizing that the apparent economy of postponing maintenance and replacements would become a greater burden as time goes on, a program of preventive maintenance, and projected replacements has been instituted. Maintenance is now scheduled on a periodic basis, so that all inspections will not fall due at the same time.

Distribution of maintenance and inspections are assigned to the personnel in the following manner. Daily lubrication and cleaning of equipment that requires oiling are assigned to the operators; periodic cleaning, adjusting, and lubrication of flow and pressure instruments are assigned to the chief operator; lubrication of equipment that requires grease, and the replacement of all worn equipment are assigned to the plant maintenance mechanic. Once a year I personally inspect everything from the building itself to megering all motors and high voltage cables. Since 1951 there has not been any

**ENTRANCE to Lafayette Filtration Plant**



ONE corner of the laboratory

FILTER plant control panel

equipment failure due to inadequate maintenance or negligence on the part of the operators.

### A Safety Program

The management of our Utilities System being aware of the importance of a safety program, has put into practice a comprehensive safety program in all departments. The activities necessary for the success of our safety program were fitted into the system's pattern of operations. Because the plant's most important asset is its personnel, the first concern has been the employees' welfare, with the objective being to make the employee's working condition as safe as the water they produce. Of course, making bacteriologically safe water is of prime importance.

Employee safety meetings are held regularly. Every employee must participate in these meetings; these meetings have done the most toward making each employee safety conscious. The frequency rate between man hours lost and million man hours worked was 11 in 1951, with a severity rate of 800. In the 1954-55 period there was no reportable accident in our water treatment plant, and I mention here that our Electric Department was awarded second place in nation wide competition in safety practice by the American Public Power Association. Yes, safety has paid dividends to our organization.

These and other refinements have been made in our plant design and operation, all tending toward the objective of effective treatment combined with the ease of operation and control, to produce a safe water of high quality at the lowest possible cost.

## Membrane Filter Procedure Now Approved as Alternate to M. P. N. Test

At the Panel discussion of the Laboratory Section of the A. P. H. A., held in Atlantic City on November 15, Professor F. W. Gilcreas announced that his subcommittee had approved the membrane filter procedure as an acceptable alternate to the standard M. P. N. test for the presence of coliform bacteria in potable waters. Professor Gilcreas acted as Chairman of the Panel Discussion and is also Chairman of the Sub-committee on Standard Methods for the Examination of Water, Sewage and Industrial Wastes of the A. P. H. A.

For publication in the Tenth Edition of Standard Methods the committee approved the membrane filter procedure as a *tentative* method only, with certain limitations. Since then many control studies have been performed under the supervision of members of the sub-committee and others. These studies have shown that it is actually possible to achieve better quality control in water plant laboratories through the greater precision and reliability of results with the membrane filter than with the older standard M. P. N. technique. Larger samples could be used and results were obtained in a shorter period. Furthermore, studies have shown that field filtration of water samples can be employed and the membrane filters then shipped to the laboratory on a preservative medium with good correlation of results.

Professor Gilcreas pointed out that the membrane filter technique would be particularly valuable in emergencies and disasters when results are needed in the quickest possible time. He also emphasized that the sub-committee still recommends the running of parallel tests, employing the M. F. and M. P. N. techniques, in each water laboratory to determine possible limitations of the M. F. method for each water supply and to check out the technical personnel and equipment. This will assure that laboratory techniques are adapted to yield results of equivalent sanitary significance.

It is understood that the subcommittee will shortly submit its report to the various technical journals concerned with Standard Methods and that the publication of this report will make the less cumbersome and faster M. F. technique a wholly acceptable alternate to the M. P. N. confirmed test for the presence of coliform bacteria in potable waters. It is further understood that this will take place before the publication of the next edition of Standard Methods, in order that the method may be made available as early as possible as *an officially approved test* for plant laboratories, commercial laboratories and public health agencies.

BASCULE gates installed on Lake Decatur dam will increase storage to supply higher water demand

# Illinois Cities Build to Meet Increased Water Demands

**The suburban movement plus greater per capita usage put a strain on Illinois waterworks, particularly during the drought period in 1953 and 1954**

THE PROBLEMS of providing essential utilities to the residents of outlying suburban communities are being felt throughout the country. The trend toward decentralization, move to the country, or the "era of metropolitan spill," began about 1940, but has been particularly noticeable since the end of World War II.

The complexities of the resulting problems have been increased by the fact that the in-city population of the nation has also increased at a rate much greater than has been predicted by biostatisticians, water works management, economists, politicians, and the other informed persons; and, thereby, creating a two-fold expansion need way out of proportion to any forecasted requirements.

Many factors have influenced the sudden move to suburban living, among which may be listed increased national prosperity, improved transportational facilities, a trend toward increased installment buying which has enabled a much greater percentage of young couples to build or buy homes than before, and many others.

**by JOHN R. TOWERS**

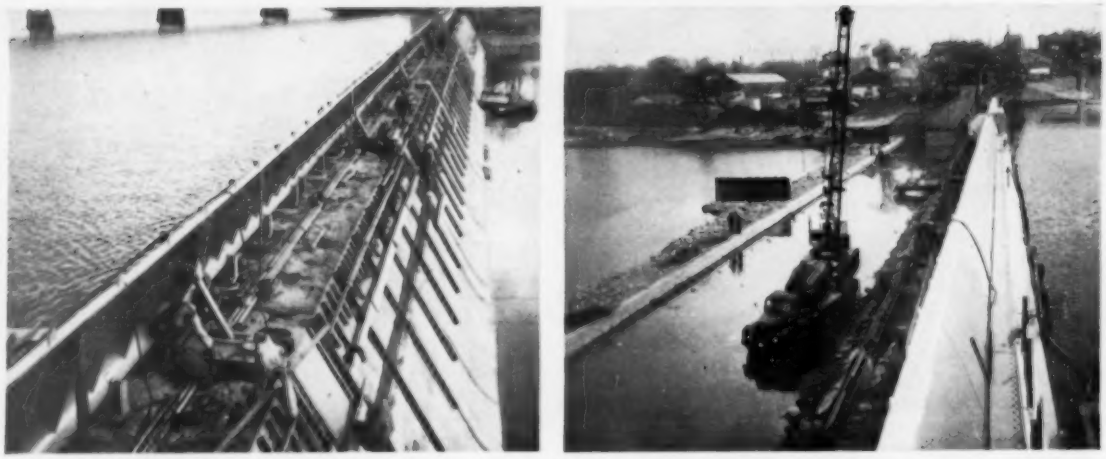
**Mr. Towers is Research Assistant, Civil Engineering Department, University of Illinois, Urbana, Ill. His interest in the subject of this paper was kindled during a water supply course as part of his graduate study.**

The water works utilities, sewage disposal facilities, construction field, schools, and churches have been and are being severely pressed to meet the needs of the people participating in this outward movement.

## The Need

The American Society of Planing Officials recently developed some interesting data from the records of three well-administered cities and, based on an average composite family group, produced the following dramatic figures. An influx of 100 new families means an increase in population of approximately 450 persons. There will be 100 new school children, requiring four additional teachers and 3.85 classrooms costing approximately $120,000. The water department will have to increase its capacity by 10,000 gpd. About 140 more vehicles will be added to traffic congestion. Several additional employees must be added to the municipal payroll to assist in the administration of water, health, police, fire, and other municipal services.

The foregoing estimates are for only 100 families, but nearly every large community today is faced with the problem of providing for many



**INSTALLATION of bascule gates at Decatur, Ill., showing downstream face (left) and upstream face (right).**
Each of two gates is 5 ft high by 233⅓ ft long; gate operators are underneath

times that number of new householders.

The U. S. Department of Commerce has recently estimated that $25 billion will be needed over the next 10 years to provide community facilities for expanding areas. This may be broken down into $10 billion worth of new construction and $15 billion to offset obsolescence and depreciation to keep pace with the rapidly increasing per capita use.

As stated by Willard F. Shephard, Director, Division of Engineering, Michigan State Department of Health: "The supply problem of suburban areas is essentially that of providing facilities that will compensate for the depreciation in existing supplies due to increasing population densities and of furnishing improved water facilities and services commensurate with the needs and resources of the community. Depreciation means the deterioration of the adequacy of supply as evaluated by criteria of quantity and quality."

In this paper an attempt is made to show the trends of the water works facilities in Illinois in their struggle to keep abreast of the problems they are facing in providing adequate service to their communities.

Questionnaires were distributed to the water service departments and companies of the major cities of Illinois to determine the individual problems and solutions with regard to meeting the needs of the community.

U. S. Census Bureau figures show an increase in population in the state from 1940 to 1950 of 815,527. Because of a change in figuring systems, it is impossible to compare the change in suburban population during the period.

## Increased Water Requirements

In the cities which replied to the questionaires, the increases in population during the period of 1945 to 1955 ranged from 3.3 to 100 percent, with the average being approximately 20 per cent. This increase in population within the corporate limits was accompanied by an increase in per capita water usage by the in-city dwellers. In 1945 the urbanities' usage ranged from a low of 54.2 gpcd to a high of 135 gpcd and averaged 93.5 gpcd. In 1955 the same communities had a low of 65.3 gpcd and a high of 160 gpcd, for an average value of 109.5 gpcd. Only one city reported a drop in per capita usage during the 10-year span.

The usage is higher in cities with a surface source of supply; the two lowest consumption rates are in cities with a ground water source and a privately-owned water treatment company.

## Service to New Suburban Areas

Several of the major cities in Illinois obtain their water supplies from privately-owned water works, among them being Peoria, East St. Louis, Champaign-Urbana, Danville, Sterling, Kankakee, and Pontiac. These utilities make no distinction between urban and suburban areas and have generally accepted the obligation to render service to all applicants. In many instances these private enterprises have had to build lines into areas which probably will not develop at a rate sufficient for prompt refinancing.

The attitudes of municipally-owned water works concerning the provision of water to new areas varies considerably from city to city. It has become the policy in several of the principal cities of Illinois to require annexation of an area to the city before water service will be provided. In some instances city ordinances have been passed prohibiting the supply of water outside the corporate limits.

Some cities have adopted the policy of providing water to a new area with the understanding that the area will eventually become annexed to the city. In most instances of the latter, the sub-divider is forced to purchase and install the distribution system for that area; which although seemingly necessary from a financial standpoint, has definite disadvantages in that the realtor or sub-divider is not well qualified to provide in an orderly, desirable way for the expansion of facilities.

Some cities, because of early practices, attempt to furnish water to the outlying unincorporated areas. The cities making an attempt to do this have felt the pressure to a considerable extent because there is a conflict between desire to service an area and the physical necessity for not doing so.

## Provision of Complete System

At least one firm has been established in the area for the express purpose of designing, constructing, and operating community water systems where municipal water supplies are not provided. Rather than the necessity for the sub-divider to construct the mains and turn them over to the municipality, the company will do it all; and purportedly more economically than the sub-divider. Some of these firms turn the facil-

**HYDRAULIC operating cylinders are located at each end of this 7-ft high by 85-ft long bascule gate at Springfield, Ill.**

ities over to the suburban community to operate if some type of governmental organization is established by the residents.

This firm, which provides central softening, cast-iron mains, and fire hydrants, will install the facilities for a total cost to the sub-divider of $620 per lot for 50 lots on 40 acres, down to $422 per lot for 240 lots on 80 acres. Rates paid by the consumers are comparable to those charged by municipalities.

Although the system mentioned furnishes an answer to the question of how to get water to residents of unincorporated suburbs of cities that require annexation before providing water, it could lead to an undesirable condition if at some time in the future the suburb should desire to be annexed to the adjacent city.

### Other Private Supplies

This complete type of system has very definite advantages over individual private supplies that are used in several areas. Whereas a resident isolated from neighbors by considerable distances can usually secure water in adequate quantity and quality by construction of an ordinary well, as an area becomes more densely populated problems of both quantity and quality may appear. This can occur as the result of an inadequate aquifier and from septic tank tile fields being located too close together.

A slight improvement over the individual well supply system is the use of a common well by several neighbors. This system is also plagued by the same disadvantages as the private well supply, but the wells are usually more adequate. Both of these systems quite obviously fail to provide fire protection of any form.

### Fire Protection

The matter of fire protection to suburban areas has created problems in outlying unincorporated areas, even where water is provided. For economic reasons cities have found it necessary to restrict fire department service to areas within the corporate limits. One solution to this problem is found in the formation of fire districts.

### Costs Expanded Too

Of the various reasons why many communities do not provide water to their suburban areas, the problem of financing treatment plant enlargement and distribution system extension is the controlling one: most communities are hard pressed financially to keep pace with the demands of their increasing population.

During the last decade construction and materials costs have climbed to an all-time high, thus greatly increasing expansion and maintenance costs. The cost of treatment has also increased significantly during this 10-year period.

In 1945, Illinois water treatment facilities utilizing surface waters as a source of supply required an expenditure of an average of $19.03 per million gallons treated. The individual treatment costs ranged from a low of $12.38 per million gallons at a plant producing 8 mgd to a high of $28.84 per million gallons at a plant treating 3 mgd of Mississippi River water. Treatment costs have risen an average of 79 percent during the 10-

**TABLE I**
**Consumer Rates for 5,000 Cu Ft of Water in Illinois Cities**

| Source of Supply | Urban | | Suburban | |
|---|---|---|---|---|
| | 1945 | 1955 | 1945 | 1955 |
| Surface | $10.68 | $10.68 | $ 9.35 | $ 9.35 |
| Surface | $11.48 | $11.48 | $11.48 | $11.48 |
| Surface | $18.78 | $23.20 | None | None |
| Surface | $ 7.50 + meter | $14.96 + meter | $11.25 + meter | $22.44 + meter |
| Surface | $ 7.60 | $ 7.60 | $ 7.60 | $ 7.60 |
| Surface | $15.75 | $16.50 | None | None |
| Surface | $13.85 + meter | $13.20 | $27.70 + meter | $26.40 |
| Surface | —— | $21.86 + meter | —— | $21.86 + meter |
| Ground | $14.72 + meter | $18.16 | $14.72 + meter | $18.16 |
| Ground | $12.84 | $18.20 + meter | $12.84 | $27.30 + meter |
| Ground | $12.50 | $21.44 + meter | $12.50 | $21.44 + meter |
| Ground | —— | $15.66 | None | None |
| Combined | $ 9.75 | $16.50 | $ 9.75 | $25.00 |

**NEW SUPPLY lines are typified by this 24-inch and 30-inch installation at Jacksonville, Ill.**

year period, with the present cost averaging $34.11 per million gallons treated. This range extended from $21.86 to $53.88 per million gallons.

At the utilities obtaining water from ground supplies the treatment is less complex than those using surface water, with iron removal and chlorination being the common treatment. In these cases, of course, the cost differential has been less drastic. An increase in cost of 40.7 per cent has been experienced, with the average cost increasing from $2.85 to $4.01 per million gallons treated.

Table 1 presents a picture of consumer rates for water in several Illinois cities for the 10-year reporting period. A basis of 5,000 cu ft was chosen for comparison purposes. A few of the treatment facilities charge a meter fee, which varies with the size of the meter.

## Added Capacity Problems

Considerable work has been undertaken around the state to increase plant capacities and extend distribution systems. Table 2 shows the design capacity, daily average production, and the percentage of design capacity represented by the average daily production in 1945 and 1955 for representative Illinois cities.

The table reveals that a majority of the cities have had to increase the treatment capacity of the plant, and also that several of those cities which have increased the capacity during this 10-year period again are approaching a condition that will require further expansion.

Several of the reporting cities found it necessary to curtail the use of water, particularly during the drought of 1953 and 1954. Curtailment was generally limited to requesting customers to water lawns less or only on specific days. A few of the cities have had to limit the amount of water to be used for air conditioning systems.

## New Facilities

The increased demand, coupled with the drought condition, also necessitated considerable expenditure of funds to improve or enlarge the source of supply for several facilities. Notable among these are the 24-mile pipeline to the Illinois River constructed by the city of Jacksonville; the construction of a new earth diversion dam and installation of 80-mgd pumps to replenish Lake Springfield at Springfield; the installation of new gates on the dam to raise the level of Lake Decatur at Decatur, thereby increasing the storage to 12 billion gallons; and the building of a new lake at Harrisburg to supplement the existing reservoirs.

All the water works, whether reporting any plant capacity increase or not, have installed a tremendous footage of distribution lines. The cities that require annexation of suburbs as a prerequisite for obtaining water service have, because of numerous annexations, laid considerable quantities of pipe.

## Summary

The unpredicted rise in poulation, increased per capita water usage, and trend toward living in fringe or suburban areas has caused the water works industry to take action in order to adequately provide for the needs of their communities.

Municipally-owned water works in Illinois have refused water to residents of unincorporated adjacent areas. Privately-owned utilities, on the other hand, make no distinction between in-city and suburban areas, although new areas often do not have sufficient customers early enough to pay for a distribution system expansion.

Suburbanites may annex to cities to obtain water; have complete treatment, distribution, and operation pro-

**TABLE 2**
**Comparative Capacity and Production in 1945 and 1955 for Representative Illinois Cities**

| | 1945 | | | 1955 | | |
|---|---|---|---|---|---|---|
| Source of Supply | Capacity, mgd | Production, mgd | Per Cent of Capacity | Capacity, mgd | Production, mgd | Per Cent of Capacity |
| Surface | 10 | 5.063 | 50.63 | 10 | 6.853 | 68.53 |
| Surface | 2.16 | 0.6 | 27.8 | 4.22 | 1.8 | 42.60 |
| Surface | 5 | 3.334 | 66.75 | 10. | 4.325 | 43.25 |
| Surface | 5 | 3.45 | 69.0 | 7.5 | 5.1 | 68.0 |
| Surface | 24 | 10.1 | 42.1 | 24 | 15.0 | 62.5 |
| Surface | 12 | 8.1 | 67.5 | 24 | 11 | 45.8 |
| Surface | 6 | 3.048 | 50.9 | 6 | 4.326 | 72.2 |
| Surface | 2 | 1.1 | 55.0 | 2.5 | 1.25 | 50.0 |
| Ground | 4 | 2.607 | 65.2 | 6 | 3.65 | 60.8 |
| Ground | 20 | 8 | 40.0 | 40 | 17 | 42.5 |
| Ground | 2.48 | 1.012 | 40.9 | 4.42 | 1.56 | 31.75 |
| Ground | 3 | 2.3 | 76.7 | 5 | 2.8 | 56.0 |
| Ground | 4 | 3.6 | 90.0 | 7 | 6.5 | 92.8 |
| Combined | 2.2 | 2.0 | 90.9 | 4.5 | 1.8 | 40.0 |

vided for their community only; have co-operative or community wells; or install individual private wells. The last two methods make it necessary to use tank truck water for fire protection.

The problems of financing water works enlargements and service extensions to the suburban areas have not been solved and become increasingly more complex with increased costs of construction and treatment.

Many water works have found it necessary to increase water rates to consumers during the last ten years and most municipally-owned utilities providing water outside the corporate limits charge a higher rate to the out-of-town residents.

**BLOOMINGTON, Ill. will bring new water into system through this 24-inch line to meet increased demands**

## Potomac River Commission Publishes "News Letter"

Each month the Interstate Commission on the Potomac River Basin publishes a four page "News Letter" on the operations of the Commission in its work of abating pollution. Persons interested in pollution abatement work will find this monthly brochure of interest. For further information, write the Interstate Commission on the Potomac River Basin, 208 Transportation Bdg., Washington 6, D. C.

## Senator Advocates Nuclear Plan to Solve Water Shortage Problems

During the week of the meeting of the Federation of Sewage & Industrial Wastes Assn. in Los Angeles, Senator Clinton P. Anderson of New Mexico addressed the Rotary Club of that city. His topic was the water shortage of Southern California and he offered a unique plan to solve the shortage.

The Senator suggested an $800,000,000 nuclear-powered distilling plant for the conversion of sea water into fresh. He admitted that the project would require Federal support but it would make possible the production of one billion gallons of water a day at a cost of from 10 to 15 cents per 1000 gallons. He suggested that the plant be built at Los Angeles where the pressure of growing population is a strong factor toward making the plan feasible. Another important factor to set the plan in motion would be to have the support of the states of the Colorado River Basin who would be glad to see Los Angeles less dependent on the Colorado River.

The Senator did not elaborate on such factors as the technical problems involved, or the justification for use of Federal funds in the solution of local water supply problems.

## Origin of the Oval Sewer

The old Roman sewers were of the box type with flat or arched tops, but always square floors. This system of sewer building has passed down the ages to this day, many of these still being in use.

The oval shaped sewer of the 18th. and 19th centuries, called the "egg-shaped sewer" with the more pointed end as an invert, was indeed an innovation of sewerage engineering. The concentration of the water carriage in the narrowed oval invert increased its flow velocity and prevented stoppage. Away back in the 12th. century the Cistertian monks of Mellifont Abbey in County Louth, Ireland, who proved themselves to be masters of many phases of civil engineering, built an oval inverted sewer. It was formed of two blocks of freestone hollowed out to the shape of the small end of an egg. It measured 18 inches across and the same measurement in depth. Above the cut stone invert, square blocks were used to form the sides of the sewer. It was covered by flat flags, all the masonry being laid in lime motar as hard as modern cement. As these monks for the most part came from France the idea of the "egg-shaped" sewer must have come from the land. This Monastic sewer of Mellifont Abbey is believed to be the earliest known sewer of this shape in the annals of sewerage engineering.—Colin J. Robb, Ballynahnich, Ireland.

## Another Honor to "Ken" Watson

Kenneth S. Watson, consultant on water management and waste control for General Electric Co., who was recently elected Vice-President of the Federation of Sewage and Industrial Wastes Associations, has just been named engineer-advisor to the U. S. delegation to the World Health Assembly in Geneva, Switzerland.

## "Jim" Symons Instructor in Sanitary Engineering at M.I.T.

Dr. John B. Wilbur, Head of the Department of Civil and Sanitary Engineering, has announced the appointment of James M. Symons of Larchmont, N.Y. as an Instructor in Sanitary Engineering for the year 1956-57. "Jim" Symons is a graduate of Cornell University, having received a Bachelor of Civil Engineering" with distinction" in 1954. Since that time he has been a graduate student in Sanitary Engineering at the Massachusetts Institute of Technology where he received his Master of Science Degree in 1955. In June 1957, he will be a candidate for the Doctor of Science Degree, having chosen for his thesis "some fundamentals of the activated sludge process."

# Lime and Lime Slaking

**by H. E. LORDLEY**

**Mr. Lordley is Assistant Director of the Department of Public Utilities in Richmond, Va. This article by Mr. Lordley is based on his own experience in the matter of handling lime.**

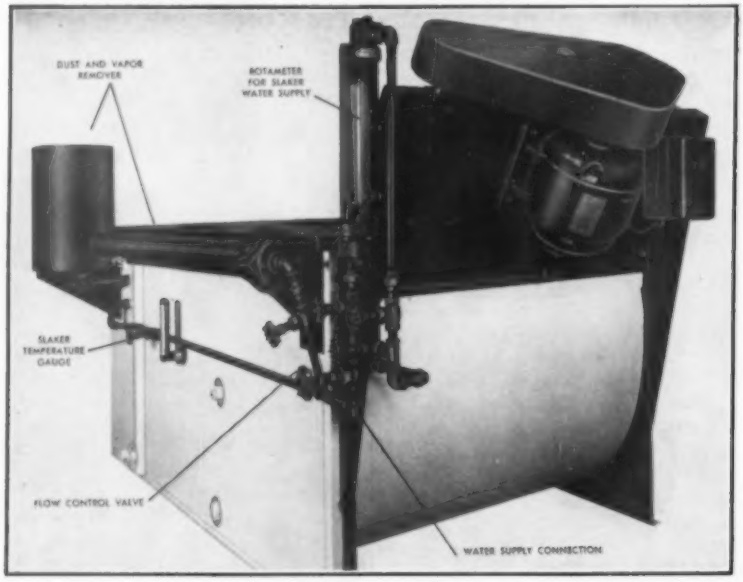
LIME IS one of the oldest chemicals known to civilization, yet today the efficient utilization of this important chemical is impeded by lack of complete information concerning its physical and chemical properties. Since lime is used in such large quantities for softening and corrosion control in the water works field, it is amazing that so little information is to be found in water works literature on the subject of lime and lime slaking.

### There is Lime and Lime

Limestone, which is the source of the calcium oxide, varies in physical and chemical properties in different parts of the country. Some limestone is high in magnesium, which is objectionable for use in water purification plants yet suitable for other chemical processes. Other sources are high in iron and silica content, so it is well to study analysis of the raw stone before buying lime for the water plant. At the lime plant, in the first step of processing the rock for calcining, a superior finished product results if mud, sand, and other impurities are removed before burning. In the actual calcining step, the manufacturer can control both the physical and chemical properties of the lime, either by the type of kiln or the method of firing. Therefore, much lime is either underburned or overburned by lack of control of the process at the kiln.

For example, the lime burned in the old style vertical kiln using coal as a source of heat without modern control equipment slakes very slowly. On the other hand, the modern controlled rotary kiln produces lime that will slake so rapidly that it actually explodes in the slaker. The author recalls an amusing incident at the Richmond water filtration plant on changing from a vertical kiln to a rotary kiln lime. The operator frantically called to report that the lime slaker was out of order and making a terrible rumble in the slaking chamber. On investigation, the new rotary kiln lime was producing miniature explosions that sounded like a loose agitator blade. Also common to the old style vertical kiln is the large percentage of core as compared to practically core-free lime from the rotary kiln. Thus it can be seen that all lime is not the same from every lime plant and the water works executive must choose the source of lime carefully if highest efficiency is to result.

Ed. Note: After 14 years, Mr. Lordley has, at our request, revised an article he wrote on this subject, to bring it up to date and incorporate current practices and economics of the improved methods of purchase, feeding and slaking of lime.




Courtesy Omega Mach. Co.

**Fig. 1.—TYPE of lime slaker used in Richmond, Va.**
Illustration shows rotameter, flow control, dust remover, and temperature gage

### Lime Properties

After the lime leaves the kiln it must be graded as to size. Quick lime can be furnished in sizes varying from a fine pulverized product, which will pass a 200-mesh screen, to a pebble lime of 2-inch size. In determining the proper size to use in the plant, the operator must remember that the pulverized lime offers both a dust problem and a feeding problem due to arching in the hopper. Dust can be controlled by proper ventilating system, but arching is just a universal worry. Arching can be partly corrected by design of lightweight hoppers having a bottom slope of not less than 60° from the horizontal.

Vibrators on the side of the hopper will further reduce arching, but the best answer is the use of pebble lime from ¼-inch to ¾-inch in size, provided suitable feeding and slaking equipment is available. Dust is reduced, arching in hoppers is elimi-

nated, and air-slaking of lime in storage is not as rapid with pebble lime as with pulverized lime.

Another physical property of interest is the color of the lime; white, gray, black, blue, etc. All are high in calcium oxide, and color is not a criterion of a good lime. The chemical properties and specifications are easy to determine in the laboratory. The lime should contain not less than 85 per cent CaO, have a low magnesia, silica, and iron content, and be free of arsenic.

In many plants today, calcium hydroxide (hydrated lime) is preferred to calcium oxide, due largely to lack of information and equipment for slaking the oxide. The lime manufacturer is anxious to dispose of calcium hydroxide, since all fines from calcium oxide are converted into calcium hydroxide at the lime plant. The water works executive must remember that he pays for the slaking process plus freight on water in hauling hydrated lime in preference to burned lime.

### Economic Considerations

In Table 1, a typical analysis and price of calcium hydroxide as compared to calcium oxide shows the economic status of the two types of lime. In buying a typical pebble calcium oxide in place of calcium hydroxide, a net saving of $7.00 per ton of CaO equivalents is realized, plus higher operating efficiency. In actual plant operation the saving will be greater, since the theoretical ratio of one part CaO to 1.32 parts $Ca(OH)_2$ approaches a practical operating ratio of 1 part CaO to 1.5 parts $Ca(OH)_2$.

Another way to save money in buying quick lime is in the size of the lime. A pulverized calcium oxide (passing a 200-mesh sieve) is more costly than a standard pebble or cracked lime. The manufacturer must charge for the expensive process of pulverizing and will raise the price of calcium oxide for the pulverized product. Also for large plants, lime shipped in 15-ton cars costs more than in 25-ton car, due to the freight rates.

With the money that can be saved by shifting from calcium hydroxide to pebble calcium oxide, an execellent feeder and slaker can be purchased and the lime treatment will become a controlled process rather than the usual "hit-or-miss" process. The operator should investigate and experiment with different types of lime to find the one best suited to his own plant and local conditions.

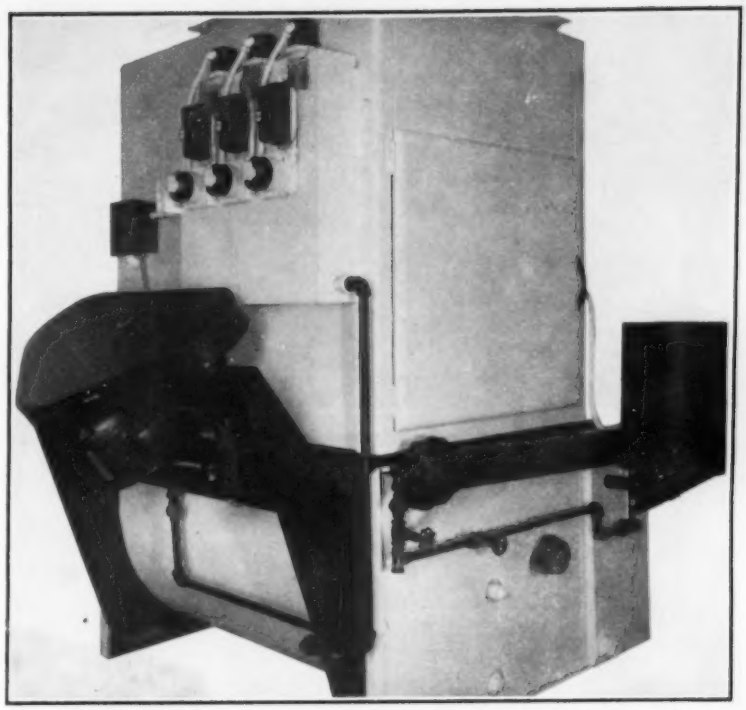


**Fig. 2—REAR VIEW loss-in-weight feeder and lime slaker, 250 lb per hour.** Note special electric heaters for Richmond, Va.

### Lime Slaking Equipment and Operation

The operation of the slaker is not easy. Like a man learning to ride a bicycle, the problem looks simple yet requires initial research and a few hard knocks before the art is mastered.

First, and most essential, is an efficient dry-feeder. In the Richmond filtration plant, an Omega lime feeder delivers the lime to the slaking vat at an exceptionally accurate rate. The feeder is of the gravimetric batch type, having a maximum capacity of 250 pounds per hour and a minimum capacity of 2.5 pounds per hour. The feeder has a 1,000-pound capacity, and a properly designed hopper equipped with an agitator and mounted on a sensitive beam scale. The adjusting mechanism for changing the rate of feed is located in a compact unit with an alarm to indicate any trouble in feeding, such as an empty hopper or failure of material to leave the hopper. The lime feed is controlled by the vibrating plate at the bottom of the hopper.

The pebble lime, not exceeding ¼-inch size, falls off the vibrating plate directly into a compact Omega slaker located on the same floor with the feeder. The unit is equipped with a water-operated vapor removal system to collect dust and steam from the slaker. The water from this unit is not wasted, but is used as make-up water for the slaker or in conveying the lime to the point of application. The slaker has a minimum retention period of 30 minutes at the maximum rate of feed and is agitated with a motor-driven impeller so adjusted as to give proper circulation in the chamber. The type of slaker used is shown in Fig. 1.

**TABLE 1**

**Economical Comparison of CaO and $Ca(OH)_2$**

| ITEM | Typical Calcium Oxide Lime | Typical Calcium Hydroxide Lime |
|---|---|---|
| Insoluble Residue, % | 1.3 | 1.2 |
| $R_2O_3$, % | 1.8 | 1.6 |
| Loss on ignition, % | 1.0 | 2.10 |
| Magnesium oxide, % | 1.9 | .50 |
| Calcium oxide, % | 88.0 | 92.00* |
| CaO equivalents, % | 94.0 | 70.00 |
| Cost, bulk, del. per ton | $17.00 | $17.50 |
| Cost, CaO, del. per ton | $18.00 | $25.00 |

Calcium hydroxide—$Ca(OH)_2$ or $CaO+H_2O$.

### Temperature Control is Important

The optimum temperature for slaking will vary both with the type of lime and the retention period in the slaker. The most efficient slaker temperature range is between 160° and 180°F; above 180°F the steam and vapor will overload the vapor re-

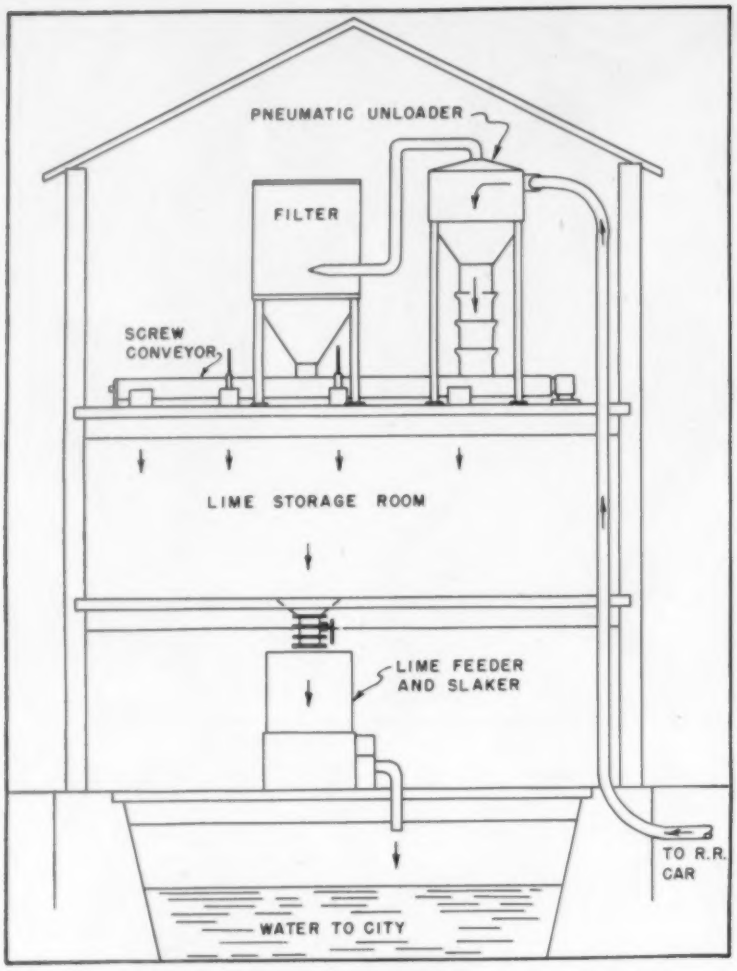



**Fig. 3—LIME HOUSE arrangement at Richmond, Va., water plant**

moval equipment and cause corrosion of the slaker and feeder. In the Richmond plant, the optimum temperature is 160°F using a pebble lime having a 96 per cent CaO content. To maintain this temperature in the shaker, with the incoming water varying between 33° and 85°F, an electric water heater of three No. M-240, 4-000-watt Chromolox immersion heaters was purchased for the job. (See Fig. 2). The heaters are equipped with three-way switches for seasonal control and thermostats on each unit to supply make-up water at a uniform temperature regardless of the temperature of the incoming water. The heat of hydration of calcium oxide is 273 calories per gram. However, in slaking small quantities of lime some of this heat is lost and must be supplemented by heat from the make-up water.

### Proper Water to Lime Ratio

In slaking lime, too little water gives a heavy slurry that is too thick to be agitated properly by the impeller, yet an excess of water increases the expense of heating make-up water and dilutes the lime so that maximum retention time in the slaker is materially reduced. Different brands of lime require variable quantities of water, but a slurry of the proper viscosity is usually obtained by a range in ratio of lime to water from 1:3 to a ratio of 1:5. After a series of experiments at the Richmond plant the ratio of 1:4 was adopted. This ratio gives excellent operating results.

**TABLE 2**

**Water Meter Reading vs Dial Setting for Optimum Ratio 1 Lime to 4 Water**

| Lime Feed, lb./hr | Dial Setting | Meter Reading,* cu ft |
|---|---|---|
| 1.75 | 1 | .3 |
| 8.75 | 5 | 1.6 |
| 17.50 | 10 | 3.4 |
| 26.25 | 15 | 5.0 |
| 35.00 | 20 | 6.7 |
| 43.75 | 25 | 8.4 |
| 52.50 | 30 | 10.0 |
| 61.25 | 35 | 11.7 |
| 70.00 | 40 | 13.5 |
| 78.75 | 45 | 15.1 |
| 87.50 | 50 | 16.7 |
| 96.25 | 55 | 18.4 |

*Special meter dial; indicates three times actual flow.

To control the ratio, a standard water meter is connected in the supply line to the heater. The meter is geared so that the lowest dial actually reads three times the amount of water passing through the meter. For example, 1 cubic foot of water passing through the meter indicates 3 cubic feet on the dial. This method was devised to afford the operator a chance to check the water flow at low rates much more readily than with the regular meter dial. After checking the flow, the operator refers to a chart (see Table 2) showing the meter reading corresponding to each rate of lime feed for a ratio of 1:4, adjustment being made by the needle control valve if necessary. Example: Feed of 50 pounds of lime per hour requires (for ratio 1:4) 50 x 4 or 200 pounds of water, or 3.2 cubic feet per hour. On the special dial this reads 3.2 x 3 or 9.6. On the chart opposite the rate of 50 pounds per hour is the value 9.6, which should be the reading of the meter for one hour. The operator adjusts the valve to get this reading. Another method of measuring the water is through use of a rotameter, as in the equipment in Fig. 1.

The lime after slaking is diluted with water from the vapor removal unit and flows over a weir into the outlet line. Some lime has considerable core. Therefore, the machine is designed for core removal, without stopping the slaker operation. The core is removed to a chamber to be washed to recover any calcium hydroxide on the surface and then is dumped into a trash can under the slaker.

### Piping Lime Suspensions

No other problem seems more perplexing than that of transporting the lime to the point of application 300 feet or 400 feet from the slaker. Many plants use rubber hose and clean the line by beating or shaking the hose. The author has found that the open trough is the simplest method of delivering the lime, provided the necessary fall can be ob-

**TABLE 3**

**Station No. 34***
**Location—Broad Rock Road**

| Determination | Before Slaker Installation 1938 | 1940 | After Slaker Installation 1956 |
|---|---|---|---|
| Res. $Cl_2$ | 0.00 | 0.00 | 0.05 |
| Turb. | 6.0 | 0.80 | 0.10 |
| Color | 40 | 10 | 3 |
| Alk. (MO) | 23 | 36 | 24 |
| Alk. (Phen.) | 0 | 4.5 | 2.2 |
| $CO_2$ | 0 | 0 | 0 |
| pH | 8.1 | 8.6 | 8.7 |
| $Fe_2O_3$ | 4.0 | 0.40 | 0.00 |

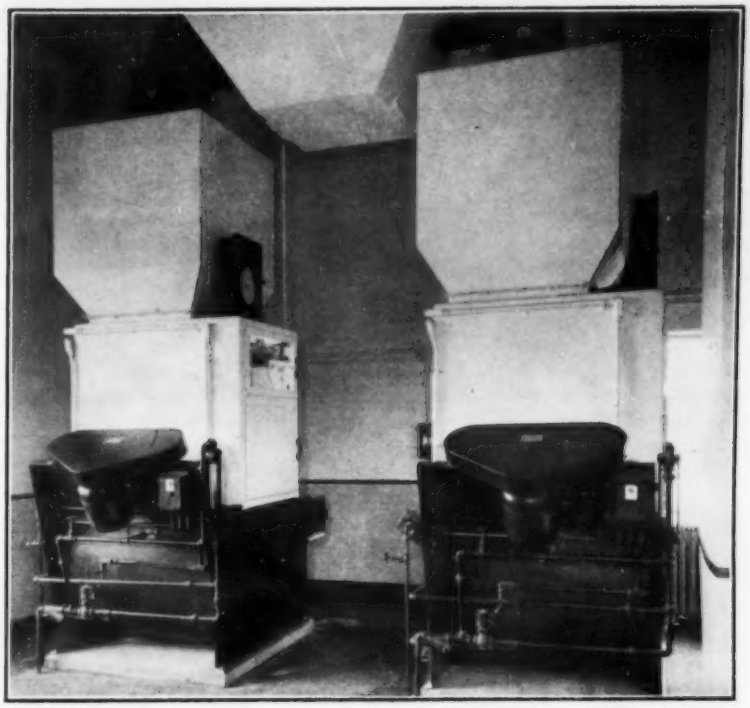
*This station is located near a dead-end.

tained between the machine and the point of application.

In the design of a new plant the solution lines can be kept to a minimum by locating equipment close to the point of application. At the new purification plant in Richmond, the lime house is located over the effluent wells and the solution line is only 3 feet in length. Fig. 3 shows the arrangement of the lime house with the pneumatic unloader, storage bins and feed machines. This system provides minimum handling of lime and no difficulties have been experienced in maintenance or operation of the machines or solution lines.

### pH Control Simplified

So accurate is the control of pH with the new Omega slaker that in the Richmond plant a constant pH of 8.7 can be held in the finished water. It is important to note in Table 3 that prior to the installation of the slaker, there was trouble in the distribution system with a decided drop in pH. With the present slaker there is only a slight drop and a corresponding decrease of iron in the dead-ends. This can only be explained by the fact that the controlled slaking is productive of a more highly peptized lime suspension—more nearly a colloidal suspension.



**TWIN installation of loss-in-weight feeders and lime slakers at Scituate, R. I.**

It is hoped that waterworks men will study lime treatment and get more lime per dollar. It must be remembered that obsolete equipment often can be scrapped and new equipment purchased with the saving, so why not have a modern plant at no extra cost?

## Cost of Aircraft Wash Waste Treatment Facilities

We wish to make a correction of statements made in the report covering the 28th Conference of the Pa. Sewage and Industrial Wastes Association—in particular, statements attributed to John E. Koruzo, Chief of the Sanitary Section, Eng. Branch, U. S. Air Force, on page 479 of our October 1956 issue.

Our report states that a plant for treating wastes from aircraft washing costs $102,000. Mr. Korozu explains that the treatment plant cost is only $27,000. The balance of the $102,000 ($75,000) is the cost of the aircraft wash rack, with piping and other attendant facilities.

The report (digest) also states that no successful process has been developed for recovery of the kerosene oil used in the wash formula. Mr. Korozu corrects this by stating that although the kerosene has added to the complication of the treatment of the wash wastes there has been no problem in the recovery of the kerosene.

At another point the airforce output of sewage is stated to approximate 28 billion gallons daily. The word daily should be yearly.

## Justin Davis Named Director of Water for Memphis

Justin J. Davis, former chief engineer of water distribution for Memphis, Tenn., has been made Director of Water, succeeding C. M. McCord who reached the mandatory retirement age recenty, as recounted in our October issue in connection with an article describing a new pumping station named in his honor.

Mr. Davis is a past-chairman of the Ky.-Tenn. Section of AWWA.

## Louisiana Fifth Water Symposium Proceedings

The Proceedings of the Fifth Annual Water Symposium of Louisiana State University are now available. The Symposium was held on Feb. 21-22, 1956. The theme of the symposium was "Water Pollution".

Articles in the Proceedings include such topics as artificial rainmaking, water resources of the south, tidal estuaries, objectives of the Federation, and industrial waste treatment and handling of such problems as the sugar industry, canning wastes, kraft pulp and paper wastes and refinery wastes.

These Proceedings have been issued as Engineering Experiment Station Bulletin No. 55 and may be obtained from the College of Engineering of Louisiana State University at Baton Rouge, La.—Price $1.75.

# Los Angeles Host to Federation's 29th Annual Meeting

THE CITY OF THE ANGELS put out its welcome mat, swept its skies clear of smog and played gracious host to the Federation of Sewage and Industrial Wastes Assns. on Oct. 8-11, 1956. Accepting the hospitality were 1032 registrants including approximately 500 persons engaged in sewage or waste treatment as operators, consultants, teachers etc., plus some 300 manufacturers representatives and approximately 230 ladies.

Although registration this year was considerably below that of the last three years, high spirit and interest were shown in the papers and exhibits. There was something for everyone: Inspection trips, banquets, entertainment, dancing, symposia, forums, award presentations, and papers on industrial waste, stream pollution, plant operation, etc., etc.

## New Officers

The following persons were elected for the ensuing year.

*President*: Emil C. Jensen, Chief, Div. of Engng. and Sanit., State Dept. of Health, Seattle, Wash.

*Vice President*: Kenneth S. Watson, Water Management and Waste Control Consultant, General Electric Co., Schenectady, N. Y.

*Treasurer*: W. W. De Berard, Deputy Comm. for Water, Chicago, Ill.

*Exec. Secy.-Editor*: Dr. Ralph E. Furhman, Washington, D. C. for a term of three years.

Geo. W. Martin
Past Pres.

Emil Jensen
President

K. S. Watson
Vice Pres.

W. W. DeBerard
Treasurer

R. E. Fuhrman
Exec. Secy.

**Officers**

## Honors and Awards

At the annual banquet, the following awards were made or announced:

*Harrison Prescott Eddy Award* for Research: To G. J. Schroepfer, W. J. Fullen, A. S. Johnson, N. R. Ziemke and J. J. Anderson for the paper on "THE ANAEROBIC CONTACT PROCESS AS APPLIED TO PACKINGHOUSE WASTES" as published in *Sew. & Ind. Wastes*, Vol. 27, p. 460 (Apr. 1955)

*George Bradley Gascoigne Award* for operation: To Henry R. King for his paper on "MECHANICS OF OXYGEN ABSORPTION IN SPIRAL FLOW AERATION TANKS", as published in *Sew. & Ind. Wastes*, Vol. 27, p. 1123 (Oct. 1955)

*Industrial Wastes Award*: To Charles R. Griffith for his paper on "LAGOONS FOR TREATING METALWORKING WASTES" as published in *Sew. & Ind. Wastes*, Vol. 27, p. 180 (Feb. 1955)

*Bedell and Hatfield Awards* were announced. The presentation of these awards will be made at the annual meetings of the several associations as follows:

| | Bedell Award | Hatfield Award |
|---|---|---|
| Calif. | A. G. Pickett | M. B. McKinnie |
| Can. Inst. | R. J. Desmarais | * |
| Cent. States | W. W. Mathews | I. G. Knobel |
| Florida | J. E. Kiker, Jr. | * |
| Georgia | C. E. Drummond, Jr. | * |
| Md.-Del. | W. McL. Bingley | C. G. Remsberg |
| Mont. | Rodney Preator | * |
| New Eng. | S. M. Hurley, Jr. | * |
| New York | Earl Devendorf | F. W. Crane |
| Ohio | B. M. McDill | A. D. Caster |
| Okla. | Wm. J. Bishop | C. L. Glenn |
| Penna. | C. H. Young | Robt. Bolenius |
| Puerto Rico | Luis R. Robles | * |
| Rocky Mtn. | * | * |
| Virginia | Richard Messer | A. F. Chamblin |
| West Va. | H. K. Gibley | * |

*Nominations to be received within 30 days after Board meeting.

G. J. Schroepfer
(Eddy)

H. R. King
(Gascoigne)

E. S. Chase
(Emerson)

W. H. Wisely
Hon. Member

**Honors and Awards**

*Charles Alvin Emerson Award*: To E. Sherman Chase "for his numerous scientific contributions to the technical literature, and for his factual approach to the art and science of sewage treatment as evidenced by his interest in the problems of operations, as well as the developments of new processes and designs, and for his outstanding record of personal service to the profession and sanitary engineering, particularly as evidenced by his contributions of time and ideas to the Federation of Sewage and Industrial Wastes Assns."

*Honorary Membership*: To William H. Wisely, "in recognition of his devotion to the promotion and development of the Federation as a national organization to provide needed service in the field of waste water disposal and in recognition of his professional services as Executive Secretary of the Federation during a critical period in its growth and development."

### Federation Business

The most important action of the Board of Directors was the adoption of a number of changes in the constitution and bylaws, significant of which were the limitation of constitutional committee chairmen to terms of five years, the elimination of voting power for constitutional committee chairmen, and the provision that absent directors must designate their own proxies for any meeting.

The board referred back to the meeting place committee for further consideration of the selection of the convention city for 1961.

Secretary Fuhrman reported the striking of a medal in honor of Dr. Karl Imhoff's 80th birthday. Membership is now at 7061 and circulation of the Journal is 8,268. Kentucky-Tennessee won the numerical growth contest with 60 new members (Central States was second with 40) and Kentucky-Tennessee also won the percentage gain contest with an increase of 50 per cent. The Federation increased its net worth to $90,274.16. The Budget for 1957 was set at $121,800.

Progress on publication of manuals continues slowly. The document prepared by the sub-committee on Standardization of Units has met with criticism and will be published in the Journal only for information and discussion purposes. The Manual on Sewer Maintenance is nearing completion; the Manual on Plant Operation will not be ready for another year. Manual No. 1 on Safety and Manual No. 3 on Ordinances are about out of print and need to be revised. Efforts are being made to reactivate the committees on these manuals.

The special committee on chlorine supply reported that specifications had been proposed to AWWA and when issued will make available to water sanitation plants a purchasing document which will (1) specify a reconditioning and packaging code for the promotion of safety of containers and cleanliness of chlorine; (2) specify a minimum standard of acceptable quality of chlorine and (3) provide a uniform basis for promotion of safety and cleanliness of chlorine.

### Inspection Trips

Persons interested in visiting plants had the choice of many, including six sewage works and four industrial waste treatment plants. The principal trip was a visit to the Hyperion Works of the City of Los Angeles.

The Hyperion plant was placed in operation in 1950 as a primary treatment plant; in 1951 the secondary or high rate activated sludge part of the plant went into service. Chlorination of the final effluent is used. Sludge is digested (half at 90 deg. F. and half at 120 deg. F.). The digested sludge is elutriated and dewatered on vacuum filters and dried in flash dryers for sale as fertilizers. The capacity of the plant is 245 mgd. Plans are now underway to increase the plant capacity and convert the plant to primary treatment only, with discharge of the effluent five miles offshore and discharge of the sludge seven miles offshore in 300 ft of water.

Optional trips were available to three Los Angeles County facilities and two Orange County plants. The County Sanitation Districts of Los Angeles County operate a primary sewage plant utilizing ocean disposal for 190 mgd. Sludge is digested and disposed of by drying beds or discharge to ocean outfall. Also available for inspection were the South Bay Cities main pumping station and two small plants serving desert communities, utilizing primary treatment and oxidation ponds. The Orange County plants available for inspection included Plant No. 1 and Laboratory on The Santa Ana River and Plant No. 2 (between Huntington Beach and Newport Beach) featuring pre-

**Program**

A. M. Rawn (Opening Paper)

V. W. Bacon

**Committee Chairmen**

T. T. Quigley (Com. Mgmt.)

R. Eliassen (Program)

K. A. Kiern (Entertainment)

**Manufacturers' Association**

J. A. Frank (President)

H. E. Schlenz (Pres. Elect)

J. G. Stewart (Manager)

D. E. Dimmers (Secretary)

Hilo Hattie Teaches the Hula

Wisely Receives Honorary Membership

dilution of sewage effluent discharged into 7000 ft outfall.

The industrial plant inspections included a brewery, soap and edible fat plant, refinery, and citrus processing plant. At the Lucky Lager Brewery, more than 0.5 mgd of high B.O.D. waste is treated in a biofiltration plant. The effluent is reclaimed by spreading on gravelly alluvium where it percolates to subsurface aquifers used for local water supply.

At the Lever Bros. soap and edible fat plant, four Bulkley-Dunton Colloidair Separators are used for removal of oil and grease prior to discharge to the County sewer system. Acid wastes are neutralized before discharge.

The Richfield Oil Corp. Watson Refinery Waste uses preskim tanks and air flotation clari-flotators to produce an effluent to meet the quality criteria of the L. A. County ordinance.

The United Processors Div. of Ventura Processors citrus processing plant recovers the citrus peel by extracting oil and drying the peel for cow-feed. Liquids left over after centrifugally separating the citrus oil are converted to molasses which is used to fortify the cow-feed.

### Entertainment

Ladies entertainment events included a sightseeing trip to Hollywood, Sunset Strip, Pacific Palisades, Marineland and Oceanarium and San Pedro Harbor. The trip stopped at Smith's Fish Shanty for luncheon. Other events were a Hospitality Tea, and a trip to Knott's Berry Farm, an interesting replica of an old California Ghost Town.

On Monday night, both men and ladies were entertained by Hilo Hattie and her Hawaiian troupe of musicians and dancers. During the course of the show, Hattie taught a number of the men how to do the hula hula, much to the amusement of the rest of the audience.

### Exhibits

Arrangement of exhibitor booths was not as satisfactory as at some previous conventions. Booths were divided between two separate rooms, one of which was away from the hallway leading to the main meeting room. Low ceilings and shallow booths hampered some exhibitors. Forty three members of the manufacturers association had exhibits and used 80 booths.

## Technical Sessions

As the Federation has grown, so have the interests of its members. It is now no longer possible to satisfy these broad interests in three days of technical sessions except by concurrent sessions. This year for the first time there were three concurrent sessions and indications are that this practice will have to continue in the future.

### Calif. Water Pollution Control System

THE ORGANIZATION AND ACCOMPLISHMENT OF THE CALIFORNIA WATER POLLUTION CONTROL SYSTEM was presented by A M Rawn and Vinton W. Bacon. Mr. Rawn is Chief Engr. and Gen. Mgr., Los Angeles County Sanitation District and Chairman of the California State Water Pollution Control Board; Mr. Bacon is executive officer of the California Water Pollution Control Board. Mr. Rawn presented the paper.

Mr. Rawn explained that the State of California is divided into nine water pollution control regions. Each region is autonomous and has a board of five members, one each representing water supply, irrigated water supply, county government, city government, and industrial waste. Each region has an executive officer and the services of the various state technical staffs. Meetings are held monthly.

The state board has fourteen members, one each representing the State Depts. of Fish and Game, Natural Resources, Public Health, Water Resources and Agriculture plus one each representing water supply, irrigated agriculture, county government, city government, industrial water sup-

Exhibits

ply, industrial waste disposal and public sewage disposal.

Mr. Rawn believes the work of these boards has been quite successful to date. It is planned to expand the work of the boards to include research and monitoring.

Under the provisions of P.L. 660, California has set up 83 needed projects and has developed a priority system based on points. This point system is determined from a combination of assessed valuation and cost per capita; California has accepted the theory of P.L. 660 and proposes to cooperate in every possible way.

Mr. Rawn also spoke of the monitoring program, and of the research project on the disposal of sludge to the ocean. A research program through the Hancock Foundation will spend $250,000 a year for five years to study the effect of sewage sludge on marine resources, ocean currents, abandoned operations, such as, trash, garbage and ash in abandoned dump sites, and other phases of the overall problem. Problems of the Hyperion plant will be studied also.

While some persons think a single state agency would be better, Mr. Rawn believes that the present regional board system is working satisfactorily.

### Research Symposium

For the second year, the program included a symposium on research. This year because of programming problems it was necessary to hold the Research Symposium concurrently with another session. Prior to the meeting some apprehension was voiced that the symposium attendance would suffer or that too few persons are interested in research to make such a symposium worth while. Attendance at the session varied from approximately 50 at the beginning of the session to 135 at the maximum and 90 at the end of the session. No doubt this feature will become a permanent part of future programs. Prof. Jack E. McKee of Cal. Tech. acted as Leader of the session.

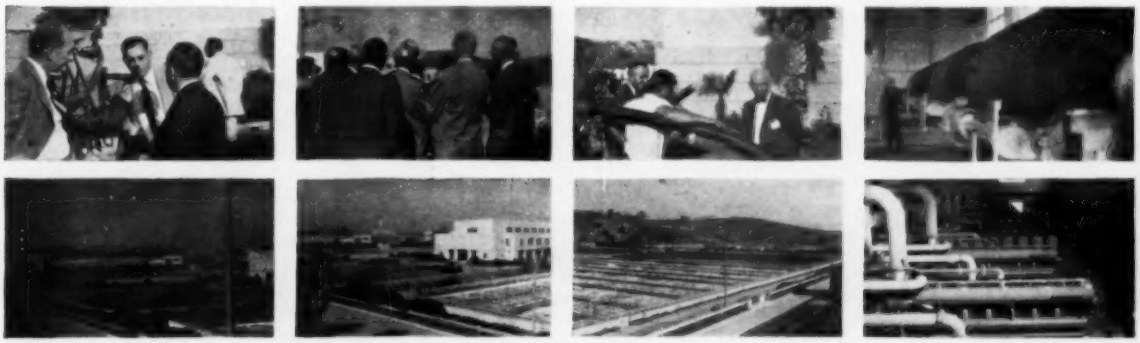
**New Jersey Contingent**
Largest Group Outside California Assn.

Harry A. Faber, Research Coordinator, office of Engineering Resources, USPHS, Washington, D. C. gave a progress report on THE SANITARY ENGINEERING RESEARCH GRANTS PROGRAM. By means of charts, Mr. Faber showed how small has been the portion of USPHS research grants made for sanitary engineering projects. Within the past three years and particularly in the last year, there has been an increase in the number of projects and amount of money granted for research in sanitary engineering. Mr. Faber did not take credit for the increase of the past year, but undoubtedly much of the current impetus is due to his efforts as Research Coordinator. There has been a large increase in number of applications, but much remains to be done to insure that sanitary engineering receives its share of PHS research funds.

W. J. Oswald spoke for his coauthors, W. R. Kellen, C. G. Golueke, and Prof. H. B. Gotaas, all of the Sanitary Engineering Research Laboratory of The University of California in Berkeley, Calif. Their joint paper was titled ALGAE IN WASTE TREATMENT. It covered the subject of energy needed by algae, that available from sunlight, types of algae, reduction of oxygen demand and recovery of algae for their protein content.

The paper was formally discussed by Prof. Ernest Glovna, University of Texas, Austin, Tex., who told of studies in Texas on the use of algae for treatment purposes without effort to recover the algae for food use. He also showed slides of some oxidation ponds using algae. Apparently this method of secondary treatment will have a future only in the warmer areas where sunshine is more consistent.

Dr. K. L. Schulze, Research Engineer, Chem. Engr. Dept., Michigan State University, Lansing, Mich. presented a very interesting paper on AN EXPERIMENTAL VERTICAL SCREEN TRICKLING FILTER. Using



**Inspection Trip-Hyperion Plant**

a wire screen and applying the waste at the upper edge, it was found that in the passage of waste down the screen in from 8 to 30 seconds, there was a practically complete secondary treatment effected. B. O. D. removals were comparable with the best activated sludge or trickling filter operations.

Growths on the screen developed to a thickness of approximately 6 mm. When whey was added to the sewage the growths were heavier, contained different organisms and sloughed off more in patches than when sewage alone was treated. With sewage only, sloughing was continuous. Microscopic studies showed both aerobic and anaerobic layers. B.O.D. removal per cubic yard of volume was excellent.

Technical Advisory Committee Assn. of Amer. Soap and Glycerine Producers, Inc. The title of his talk was DETERGENT ABS IN SEWAGE AND RECEIVING WATERS—ANALYTICAL DEVELOPMENT WORK BY AASGP.

Mr. House reviewed the history of the formation of the analytical committee and the need for improved analytical methods for ABS. Interest in analytical methods arose because of complaints that detergents caused operating difficulties in sewage even though the concentration was extremely low.

Colorimetric methods suggested were usually subject to interference; titration methods are good at concentrations of 100 ppm but doubtful at the low concentrations existing in sewage and receiving waters.

tatives was held Wednesday afternoon, October 10, in Los Angeles, in connection with the 29th Annual meeting of the Federation of Sewage and Industrial Wastes Association.

The first meeting was held a year ago at the Atlantic City meeting of the Federation, when federal legislation to extend and strengthen the federal water pollution control act, was half way through Congress.

This year's Water Pollution Control Symposium drew an attendance of representatives of twenty state control agencies and two interstate groups.

The enactment of P. L. 660 of the 84th Congress and supporting first year appropriations both for administrative assistance to state and interstate agencies as well as construction

J. E. McKee

H. A. Faber

H. B. Gotaas

E. F. Gloyna

Research Symposium

K. L. Schulze

J. B. Coulter

J. B. Coulter spoke for his coauthors, A. Soneda, and M. B. Ettinger all of the Robt. A. Taft San. Engng. Center of the USPHS at Cincinnati. The title of the paper was ANAEROBIC CONTACT PROCESSES FOR SEWAGE DISPOSAL. It describes a system designed for the treatment of sewage at small housing developments. The system used consists of upward flow through an anerobic sludge blanket. The device is cone shaped to reduce carryover of solids. The effluent from the cone is passed upward through submerged rock. Removal of solids is quite good and digestion produces gas and considerable liquefaction of solids. The effluent is better than the effluent from septic tanks and an improvement on that method of treatment for small installations. Studies are continuing.

### Laboratory Scientists

A special breakfast session for laboratory scientists drew 32 persons. W. F. Garber, Laboratory Director, Hyperion Sewage Treatment Plant, Los Angeles, presided. Ralph House, Research Chemist, California Research Corp., Richmond, Calif. spoke in his capacity as Chairman of the Subcommittee for analysis of ABS,

The referee committee set out to develop a method that would assure both complete or reproducible recovery of ABS and positive identification of the recovered material in water. The method was developed in several cooperating laboratories and tested cooperatively on Ohio River water.

The method involves adsorption of ABS on activated carbon, elution, purification by acid hydrolysis and extractive techniques, and final estimation and identification by infrared spectroscopy. The procedure is lengthy and not suited for survey work, but is suited for referee purposes.

The committee is currently investigating a similar method for use in sewage and cooperative testing is expected soon. Future work of the committee will be directed toward development of a short method for water and sewage; one which is simple and quick enough for general survey work.

### Water Pollution Control*

The second meeting within a year of state and interstate water pollution control authorities or their represen-

*Reported by Milton P. Adams, Exec. Secy., Mich. State Stream Control Commission.

grants for eligible and qualifying municipalities has raised new problems which were found to vary from state to state throughout the country.

Mark D. Hollis, Chief Engineer of the U. S. Public Health Service described briefly the several sections of the law and the procedural problems encountered by the Public Health Service in laying the ground work for carrying out congressional and executive department objectives.

Gordon E. McCallum, Chief, Water Supply and Water Pollution Control Program, USPHS presented a detailed status report of federal activities particularly with reference to Section 6 of the Act. Among other things—as to program grants for state and interstate agencies, he said necessary Regulations had been approved and published in the Federal Register. Instructions and Payment Request forms (for use of states in requesting payment from the grant allotment) have been approved and are at the printers.

The necessary paper work and forms dealing with construction grants consisting of Application Forms, Instruction, State Program Approved and Certification of Priority Forms—approved by Bureau of the Budget and at the printers. Con-

struction Grant Regulations, Offer and Acceptance Forms are completed and in process of clearance. A Procedure Manual is being reviewed by the Department and Schedule of Criteria and still awaits decision and clearance by the Executive Department.

Following priority certification of eligible projects by the states, Mr. McCallum indicated the following steps would be necessary before actual grant money is assured for construction assistance. These are:

1. Grant offer is made by Surgeon General subject to necessary requirements of the law and regulations.
2. Upon approval of construction plans and specifications by State Water Pollution Control Agency and Public Health Service, applicant is notified by letter to advertise for bids.
3. Applicant completes Offer and Acceptance Form returning same to the regional office, Public Health Service, through the appropriate state agency.
4. Regional Office (all conditions being met) authorizes applicant to award contracts.

Among questions raised by panel members and the states and answered by Federal representatives were these: Step or stage programs would require legal consideration and opinion on presentations of all facts and data involved, projects let prior to July 27, 1956, could not be considered as eligible for grants.

The Service according to Mr. McCallum is in need of more basic data and hopes for state and interstate cooperation in the following directions:

1. A National water quality basic data program related to sewage and industrial waste pollution.
2. A complete and current national inventory of water, sewage and industrial waste treatment facilities.
3. A detailed basic data program related to economics of water supply and pollution control.

From the great lakes states of Ohio, Indiana, Michigan and New York, as well as California, the inadequacy of the amount of construction grant funds was stressed. Unless more money is made available, progress of these states at least will be slowed rather than accelerated by provisions of Section 6 of the Act. One of the problems experienced by all states and so far solved by few is a satisfactory and equitable method of certifying priority as between eligible state projects. Differing conditions and objectives in various sections of the nation will necessarily mean a different priority criteria for the several states.

A. F. Dappert, Executive Secretary, Water Pollution Control Section of the New York State Department of Health, D. F. Smallhorst, Public Health Engineer, Texas State Department of Health and Edward J. Cleary, Executive Director and Chief Engineer, Ohio River Valley Water Sanitation Commission comprised the primary panel members. Their questions were supplemented by those of representatives of other states represented. Some 200 persons were present for the panel presentations and discussion in addition to official state and interstate representatives. Milton P. Adams, Executive Secretary, Water Resources Commission of Michigan acted as leader of the session.

Appreciating the need of further mutual consultation and particularly the need of advance agreement if possible on future amendatory legislation, a resolution was unanimously adopted calling upon the Federation Board of Control to request the Surgeon General of U. S. Public Health Service to create a Surgeon General's Conference of State and Interstate Water Pollution Control Authorities. Such a conference, if organized would be representative of all state and interstate interests. Neither the Federation itself, the Conference of State Sanitary Engineers or the Association of State and Territorial Health officers completely answers this requirement.

There is past precedent for the establishment of such a conference in the field of water pollution control as the result of federal action already taken in the field of Hospitals and Mental Health.

**Water Pollution Control**

M. P. Adams — M. D. Hollis — A. F. Dappert — E. J. Cleary

## Who Knows If This Is True?

In a news clipping from The Hague it is stated that the World Federation for Animal Protection is making an effort to stop the scheme of sewer cleaning employed by Nice, France.

The Nice system, which isn't very nice, consists of tying sewer cleaning brushes to the tails of dogs which are chased through the sewers from manhole to manhole.

## Jersey Section's New Officers

**Ohland, Chairman; Pleibel, Secy-Treas.**

The New Jersey Section of A.W.W.A. at its recent Atantic City meeting elected the following officers. After serving the Section 17 years as its secretary-treasurer "Cy" Tygert of Wallace & Tiernan Co. resigned. To take his place Alfred F. Pleibel of R. D. Wood Co. was elected secretary-treasurer.

*Chairman*
Harold M. Ohland, Jersey City, N. J.

*Vice Chairman*
Martin E. Flentje, Merchantville, N. J.

*AWWA Director*
Charles J. Alfke, Weehawken, N. J.

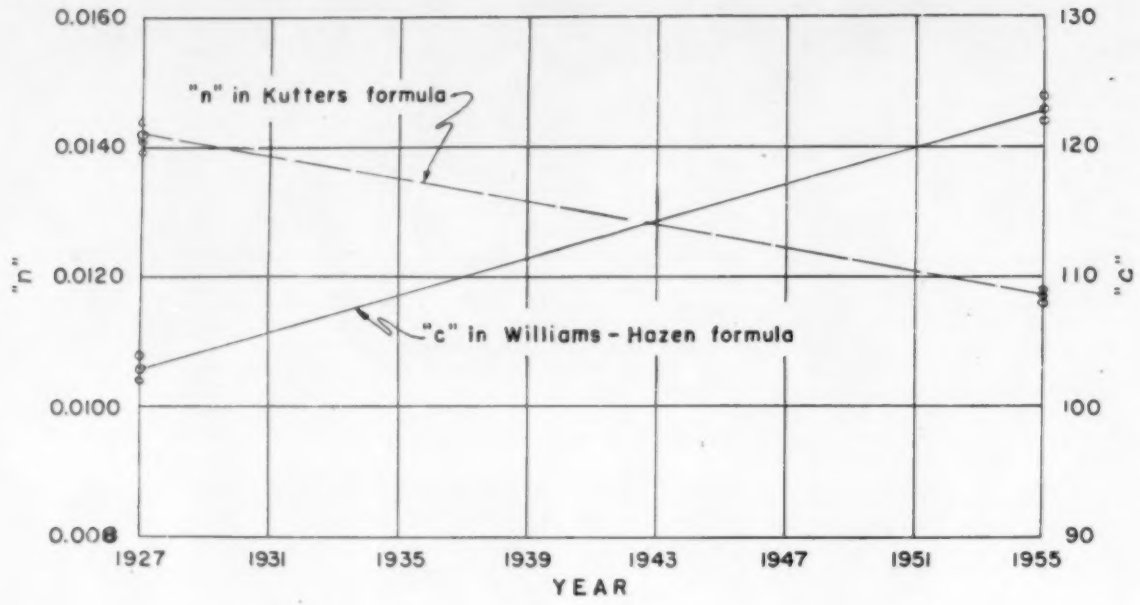
*Sec'y-Treasurer*
Albert F. Pleibel, Maplewood N. J.

*Trustees*
John J. Reager, Perth Amboy, N.J.
Lewis W. Klockner, Trenton, N. J.

## Water Supply Expansion in Mexico Opened to U. S. Bidders

A project for expanding the existing water supply of the city of Monterrey in Mexico, estimated at more than $8 million was opened to United States Bidders by the Water Commission of the State of Nuevo Leon.

Plans call for supply of pipe and materials for construction of about 30 kilometers of 48-inch pipe line from Villa Santiago to Monterrey, building of the pipeline, and expanding the existing water distribution system in Monterrey. The improvement will increase Monterrey's water supply by approximately 1000 liters per second (approx. 1550 gpm) over the present estimated capacity of about 750 gpm.




# A Sewage Force Main Improves With Age

**Friction losses in Baltimore's 42 inch cast iron sewage force main decline during 28 years of service.**

by C. E. KEEFER*
Assistant Sewerage Engineer
Baltimore, Md.

IN 1927 the friction losses in one of two 42-in. cast-iron force mains almost a mile in length, through which sewage discharges from the Eastern Avenue pumping station in Baltimore, were determined after the main had been in service for almost 15 years[1]. Then, after 28 years of additional service, (43 year total service) the friction losses were again determined in 1955. Opposite to the usual experience with cast-iron pipes which convey water, it was found that instead of an increase in friction losses with age there had been a reduction in friction losses during the 28 year period between 1927 and 1955.

The force mains consist of two parallel pipe lines, each 5280 ft. long, containing both class "A" and class "B" bell-and spigot pipe, made in accordance with the specifications of the New England Water Works Association. Each pipe line contains one 42x21-in. Venturi meter tube four 42-in. gate valves, one ¼ bend, two ⅛ bends and twelve 1/16 bends. The pipes were laid in 1909; and after they were put in service in 1912, flow through them has been continuous during the 44 year period (1912-1956) except on four occasions when they were shut down for short periods of time for repairs.

The results of the first series of tests, which were made on January 3, 1927, after approximately 65 billion gallons of bar-screened sewage had been pumped through the 42" main, are given in Table I. The value of *"c"* in Williams and Hazen's formula, varied from 102 to 104, and *"n"* in Kutter's formula ranged from 0.0144 to 0.0139.

Since it was planned to electrify the pumping station, by replacing the three steam-driven triple-expansion sewage pumps by motor-driven centrifugal pumps, it was decided in 1955 to see if there had been any material change in the friction losses in the pipe line in the intervening years. Three tests were made on April 13, 1955. Sewage was pumped through one of the force mains (Table II) at rates varying from 16.6 to 24.4 m.g.d. and with velocities ranging from 2.65 to 3.91 ft. per sec. The calculated value of *"c"* in the Williams-Hazen formula varied from 122 to 124 and the value of *"n"* in Kutter's formula varied from

(1) Keefer, C. E. and R. T. Regester: "Friction Loss in a 42-in. Force Main at Baltimore." Eng. News-Rec. 100, 360 (1928).

*Editorial Associate, *Water & Sewage Works*

0.0116 to 0.0118. During the intervening 28-year period when an additional 179 billion gallons of sewage had been pumped, there was a material reduction in the friction in the pipe line.

Sewage was pumped through the force main by means of a 30-in. centrifugal pump, operating at a speed of 490 r.p.m. The pressure head in the force main was determined by a mercury U-gauge, which was attached to the force main beyond the discharge nozzle of the pump, and the elevation of the surface of the sewage was measured at the outlet of the force main. The formula $h = 0.00168\ v^2$ was used to calculate the loss of head in the Venturi meter tube, and W. E. Fuller's formula $h = kv^{2.25}$ was used to determine the loss of head in the pipe bends in excess of that in straight pipe. No allowance was made for the loss of head in the 42-in. gate valves, which were wide open. In calculating the friction coefficients the full diameter of the pipe was used although the cross-sectional area of the pipe was somewhat reduced due to a coating of slime on the pipe interior.

**TABLE I—Results of Friction Test on 42-in. Cast-Iron Sewage Force Main January 1927**

| Sewage Pumped (m.g.d.) | Veloc. ft./sec. | Friction Loss (ft./1,000) | "c" Williams & Hazen | "n" Kutter |
|---|---|---|---|---|
| 28.5 | 4.55 | 2.182 | 102 | 0.0141 |
| 28.6 | 4.56 | 2.125 | 104 | 0.0139 |
| 23.6 | 3.77 | 1.542 | 102 | 0.0142 |
| 24.2 | 3.86 | 1.634 | 102 | 0.0144 |
| 24.1 | 3.85 | 1.591 | 103 | 0.0142 |

### Action of Sewage on Force Main

The action of the sewage on the force mains was different than if clean water had been pumped through them. The interior of water pipes, after a number of years of service, become incrusted with scale and tubercles, which greatly increase friction losses. On the other hand, the interior of the force mains in question had a shiny gelatinous coating that offered little resistance to the flow of sewage. Wherever this coating was removed, the pipe presented a smooth surface, free of tuberculation. It is believed that the decrease in the friction in the force main during the intervening period from 1927 to 1955 was due to higher velocities in the force main, which tended to reduce the thickness of the deposit on the interior of the pipe and consequently to increase the effective cross-sectional area of the pipe.

The Bureau of Sewers is under the general director of George A. Carter, director of public works and John J. Hunt, sewerage engineer. Dr. Abel Wolman is consultant to the Department of Pubic Works.

**TABLE II—Results of Friction Test on 42-in. Cast-Iron Sewage Force Main April, 1955**

| Sewage Pumped (m.g.d.) | Velocity (ft./sec.) | Total Head (ft.) | Static Head (ft.) | Head Loss Estimated* (ft.) | Velocity (ft.) | Friction Head** (ft.) | Friction Loss (ft. per 1,000) | "c" Williams & Hazen | "n" Kutter |
|---|---|---|---|---|---|---|---|---|---|
| 24.4 | 3.91 | 63.70 | 55.05 | 1.47 | 0.48 | 6.70 | 1.214 | 122 | 0.0118 |
| 23.4 | 3.73 | 63.09 | 55.91 | 1.24 | 0.10 | 5.84 | 1.074 | 123 | 0.0117 |
| 16.6 | 2.65 | 56.68 | 54.65 | 0.50 | 0.48 | 3.05 | 0.561 | 124 | 0.0116 |

*Due to bends and Venturi tube

**Based on straight pipe

## "Watershed Workshop" Held In Philadelphia, Pa.

The American Watershed Council joined with over twenty state and regional organizations to hold a "Watershed Workshop" for the middle Atlantic states at the Sylvania Hotel in Philadelphia, Penna. on November 15 and 16.

The official sponsors along with the Council were the Pennsylvania State Chamber of Commerce, the New Jersey State Chamber of Commerce and the Delaware Valley Council. Co-chairmen of this event were Clayton M. Hoff, Executive Vice President of the Brandywine Valley Association, Wilmington, Del. and Dr. Maurice K. Goddard, Secretary of the Pennsylvania Department of Forests and Waters.

The purpose was to provide practical assistance to people interested in starting or already engaged in local watershed association programs. The meeting was open to the public.

Some of the key subjects which received attention were:

The principles involved in forming and operating local watershed associations.

Watershed associations by size and type.

Preparing watershed work plans.

Action in the field and the execution of local projects.

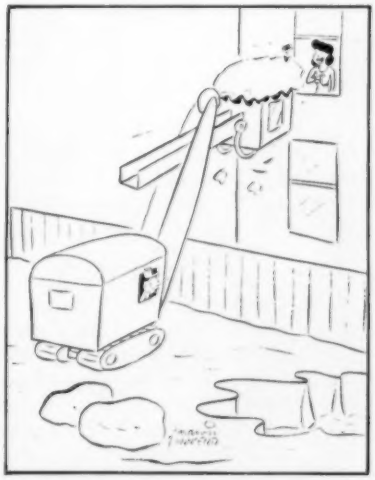
Public information and publicity.

Financing watershed associations.

Agency Cooperation—local, state and federal.

Discussion of mistakes to avoid.

The emphasis at the workshop was on answering questions vital to the success of local programs and considerable floor discussion is anticipated.



**Oh! how very sweet of you, Henry: A little forget-me-not—and, so early in the morning.**

# Raw Sewage Lagoons*

## A boon to the small municipality

by GLEN J. HOPKINS and JOE K. NEEL

**Mr. Hopkins is Sanitary Engineer Director, and Mr. Neel is Biologist in the Water Supply and Water Polluton Control Program of the U. S. Public Health Service in Kansas City, Mo. In this article they discuss raw sewage lagooning practice in the mid west.**

LAGOONS have long been associated with liquid waste disposal. Lagooning is a common process involved in treatment of concentrated industrial wastes, and some lagoons are merely basins in which wastes are stored prior to their treatment or ultimate disposal. They have gained recognition as oxidation ponds for secondary sewage treatment in California and the Southwest; and in the Midwest they have recently demonstrated a capacity for treatment of raw sewage that has resulted in their installation as permanent waste treatment facilities at a large number of small and medium-sized municipalities. Their use in this respect began in 1928 when Fessenden, N. Dak., diked off a portion of a pothole lake to receive its raw sewage discharge. This structure, although not now considered a true lagoon by the State water pollution control agency, has nevertheless functioned rather satisfactorily for 27 years.

### History and Status of Lagoons

The merit of this type of sewage treatment gained recognition slowly and no more lagoons were constructed until 1948, when a 10 acre facility was installed to receive raw wastes from about 1,000 people at Maddock, N. Dak. The success of this facility attracted statewide attention and, with the approval of the State Department of Health, lagoons were soon consructed at several other municipalities. Utilization of lagoons then spread to surrounding States, and today their use as raw sewage treatment devices at appropriate locations is regarded favorably by State water pollution control agencies in North Dakota, South Dakota, Montana, Wyoming, Nebraska, Missouri and Colorado. Kansas and Minnesota have used raw sewage lagoons under restricted circumstances. As of January 1, 1956, thirty-eight raw sewage lagoons were in operation in North Dakota; South Dakota had 18, Nebraska 5, Wyoming 5, Montana 15, Kansas 1, Missouri 7, Minnesota 2, and Colorado 9. This totals 100 for the Missouri Basin States. Limited data for each installation are appended hereto. Towns using these facilities vary in population from 150 to more than 10,000. Some units serve the daytime requirements of small numbers of people located at defense installations and public schools.

Although a general feeling now prevails that satisfactory treatment may be realized from introduction of raw sewage directly into a lagoon, a number of older lagoons serve as secondary treatment facilities. Thirty-eight known installations are distributed as follows: Colorado (1), Kansas (18), Missouri (1), Nebraska (4), North Dakota (3), South Dakota (6), and Wyoming (5). Preceding preliminary treatment may include septic tanks, Imhoff tanks, screening, sedimentation, separate sludge digestion, aeration, or chemical precipitation.

Investigations of performance and processes involved in raw sewage lagoons have been rather limited in number. Efficiency of various lagoons has been evaluated by State Health Departments in North Dakota, South Dakota, Montana, and Wyoming. The Public Health Service has cooperated with North Dakota and South Dakota in periodic investigations of lagoon processes. In 1954 a cooperative investigation of an experimental lagoon at Kearney, Nebraska, was initiated by the City of Kearney, the Nebraska State Department of Health, and the Missouri Drainage Basin Office of the U. S. Public Health Service. This study covered a 13-month period of operation and a report will soon be released.

In 1955, the Robert A. Taft Sanitary Engineering Center, U. S. Public Health Service, began a comprehensive investigation of a limited number of existing lagoons in the Dakotas. This work is continuing and a progress report of 1955 activities will be released in the near future. No data from that study enter into this presentation.

### Design Features

Utilization of lagoons for treatment of raw sewage originated in a sparsely populated region where land values are relatively low and the majority of municipalities are below 1,000 in population. There, lagoons were first regarded as virtual waste detention chambers. Biological activities prevented nuisance development, and evaporation and seepage were relied upon to maintain water below the overflow level and minimize contamination of surface streams. Percolation into the ground rapidly merited consideration as lagoons were generally constructed in tight soils and at locations where they were assumed to have no influence upon ground water supplies.

Investigation of lagoon performance soon demonstrated that they drastically reduced pollution and that overflow or effluent from adequate facilities would cause no degradation of receiving streams. Thereafter curtailment of effluent received less attention and overflow lagoons were permitted where circumstances indicated their desirability. Lagoons of the latter type are becoming more numerous than those designed to afford virtual retention.

Lagoon performance depends upon several features that are largely controlled by design. Adequate circulation and uniform distribution of wastes throughout the contained liquid are required for optimum operation. Circulation may be assured by a location fully exposed to wind action and a depth-area relationship low enough to insure complete mixing.

Optimum depth for a ten acre lagoon seems to be around four feet, but a 20-acre lagoon may function satisfactorily with depths of 7 to 8 feet. Waste distribution is most easily controlled by location of the inlet at or near the center. Side inlets have a tendency to form sludge beds and are generally considered undesirable.

Embankments or dikes should be elevated to minimize entrance of sur-

* Presented at the 11th Annual Purdue Industrial Waste Conference. Published here by permission.

**EXPERIMENTAL lagoon at Kearney, Nebr.**
Inlet lines are usually sunk below bottom level, but seepage necessitated banking at this installation. The building houses a stage recorder for the Parshall flume.

face runoff, as dilution usually serves no useful purpose. Soil types generally considered most desirable are relatively nonporous mixtures that will permit little infiltration at the start of operations. Very porous soils should be avoided whenever possible as great losses to seepage will slow water rise to an optimum level and hamper development of desirable lagoon processes. Seepage effects upon ground water must be considered if nearby wells exist.

Dikes should be constructed of soils containing considerable percentages of clay or have the water line area shielded against wave action by riprap or other protective measures. Sealing of bottoms progresses with time and fairly porous soils usually become relatively impermeable within a few years. Bottom sealing and resultant decreases in percolation has transformed some retention lagoons into overflow types, and in some cases has necessitated construction of additional lagoons in areas where complete retention is desired.

Economical bottom impermeabilization is a factor of primary importance in extending the use of lagoons into areas of excessive soil porosity. Inexpensive materials such as bentonites and soil blankets offer some promise after limited experimentation; and it appears that their applicability in this respect should be thoroughly explored, as more expensive methods may place lagoons beyond the reach of smaller municipalities.

It is not necessary to consider volume loss from sedimentation in lagoon design, as sludge accumulates in well functioning lagoons at a rate that would require more than a hundred years to produce an appreciable loss of capacity.

The majority of lagoon facilities consist of single chambers which eventually overflow into nearby drainage channels. In some instances raw wastes are discharged into two chambers in a parallel operation, and in a few cases one or more units are operated in series from a primary chamber receiving the raw sewage. The latter type of facility furnishes the greatest degree of wastes reduction but additional purification so afforded is rarely necessary. Added units in a series installation do not reduce the size required for the primary unit.

Capacity now recommended in the Dakotas and Montana is one acre for a four foot lagoon, or four acre-feet per 100 population or equivalent. This recommendation is based upon successful operation of earlier lagoons with such loadings. It assumes that four acre-feet are required to stabilize a daily B.O.D. load of 16 to 20 pounds. To some this loading has appeared too low to realize the maximum potential inherent in lagoon processes. Experiments at Kearney, Neb., where loading at times exceeded 1,000 people per acre, indicated that lagoons would adequately handle a substantially greater load. The State of Missouri was impressed by the Kearney studies and now permits a loading of 400 people per acre. for interim treatment.

### Cost Data

Lagoon costs are influenced by the price of land, topography, price of excavation, length of outfall sewers, and other factors. As for other forms of sewage treatment, accurate cost data are usually difficult to obtain. The South Dakota State Department of Health has obtained rather complete cost data on many installations in that State, and this information is available to all interested persons.

For fifteen South Dakota towns varying in population from 367 to 2,871, and averaging 1,102, land costs ranged from $950 to $12,375, averaging $3,558 per installation or $3.23 per capita. Construction costs varied from $4,276 to $31,000, averaging $14,385 per installaton or $13.06 per capita. Total costs were from $5,276 to $42,139, averaging $17,943 per installation or $16.28 per capita. For the three largest communities (2,500 to 3,000 inhabitants), per capita costs averaged $2.78 for land, $10.73 for construction, and $13.51 for the complete facility. For the three smallest communities (below 400 population) per capita prices averaged $1.38 for

**TYPICAL Dakota Installation**
This 1.75 acre lagoon serves a village of 250 persons.

land, $7.38 for construction, and $8.76 for the complete facility.

Under conditions prevailing in South Dakota, lagoons for very small communities can be provided at a per capita cost comparable to that for communities in the 2,500 range. Virtually complete treatment resulted at lesser per capita cost than is required for conventional primary treatment. Unquestionably, where lagoons can be used successfully, sewage treatment is available at reasonable cost, even for small communities.

### Maintenance

Lagoons require maintenance only to the degree of protecting dikes from erosion and animal damage, and controlling certain undesirable aquatic growths. Seeding and fencing are major items in dike protection, although periodic control programs may need be directed at burrowing animals such as crayfish and muskrats. Dikes constructed of light soils may require protection against wave erosion by riprapping or layers of heavy soils at the water line. Aquatic flowering plants and attached algae produce losses in effective capacity and interfere with circulation. While this problem has not been a major one, maintenance should provide for periodic inspection and removal of such growths.

### Operational Features

Early successful use of raw sewage lagoons occurred in a region (North Dakota) where they were normally covered with ice for about five months (November to March) each winter. Ice and snow cover and low temperatures restricted biological activities during this period, but ice formed an effective barrier between lagoons and the atmosphere and no nuisances developed. Biological processes, particularly the critical algal growth, developed with the spring thaw and promoted aerobic treatment processes. Thus actual sewage treatment alternated with a static period in which degree of treatment was of little consequence. This condition seems normal for lagoons operating in the Dakotas, Montana, Minnesota, and Wyoming. Overflow lagoons in those areas produce a lower quality effluent during winter months, but its assimilation into receiving streams has posed no problems.

In Nebraska ice cover lasts from about December 1 to March 1. Brief periods of cloudy weather may produce anaerobic conditions of short duration in November and March, particularly with a heavily loaded lagoon, and liberate some odor to the atmosphere. With proper loading, however, odors produced by no means constitute nuisance conditions. At more southerly latitudes (e.g., Missouri) only intermittent ice cover is expected and observed lagoons normally change from aerobic to anerobic status and back several times during the winter. Oxygenless conditions are usually associated with ice cover, and recoveries to aerobic conditions are quite rapid as ice cover disappears. Lagoons in Missouri are discharged to watercourses and winter deterioration in effluent quality is usually not as great as in areas where ice persists two or three months without interruption.

The midwestern States utilizing raw sewage lagoons exhibit wide climatic variation. Average annual precipitation ranges from about 14 to more than 50 inches. Evaporation from shallow lakes and ponds varies from 36 to 59 inches per year, and exceeds annual precipitation over a range of 4 to 31 inches. Average annual temperature varies from 35° to 60°F. The fact that lagoons of essentially similar design have performed satisfactorily over this wide climatic range argues well for the adaptability of biological processes involved. However, it appears that some modifications in loading, and probably other design criteria, may result in greater efficiency.

### Processes Involved

Wastes reduction in lagoons largely represents the cooperative effort of bacteria and algae. Bacteria are mainly involved in breakdown of complex organic compounds to provide a large share of nutrient materials required for algal growth. Algae produce great volumes of oxygen by photosynthesis, the only natural process capable of maintaining an aerobic medium under such conditions. They utilize energy supplied by sewage compounds in their life processes, and incorporate large amounts of energy and sewage materials into their bod-

# RAW SEWAGE LAGOONS OPERATING IN MISSOURI BASIN STATES—JAN. 1, 1956

| Location | Population Served | Number of Cells | Total Area (Acres) |
|---|---|---|---|
| COLORADO | | | |
| Alamosa | 6,000 | 3 | 47 |
| Altura (S.D.) | 2,000 | 2 | 20 |
| Fountain | 2,000 | 2 | 3 |
| Keenesburg | 150 | 2 | 5 |
| Kersey | 245 | — | — |
| Norwood | 300 | 1 | 7 |
| Nucla | 500 | 2 | 5 |
| Otis (S.D.) | 250 | 1 | 4 |
| Strasburg (S.D.) | 400 | 1 | 5.5 |
| KANSAS | | | |
| Frankfort | 1,000 | 3 | 15.2 |
| MINNESOTA | | | |
| Albany | 1,075 | 2 | 50 |
| Warren | 1,600 | 2 | 51 |
| MISSOURI | | | |
| Alam | 350 | 1 | 3 |
| Clay Co. (Sherwood Est.) | 175 | 1 | — |
| Jackson Co. (Fairlane) | 1,520 | 1 | 3.1 |
| Jackson Co. (Western Hills) | 1,250 | 1 | 3.25 |
| Montgomery City | 1,200 | 1 | 12 |
| Paris | 1,100 | 2 | 15 |
| Perry | 500 | 1 | 5 |
| MONTANA | | | |
| Big Sandy | 700 | 1 | 9 |
| Brady | 240 | 1 | 2.74 |
| Brockton | 350 | 1 | 2 |
| Charlo | 250 | 1 | 2.8 |
| Chester | 700 | 1 | 9 |
| Choteau | 1,600 | 1 | 30 |
| Circle | 600 | 2 | 15 |
| Denton | 440 | 1 | 4.8 |
| Dillon | 4,000 | 1 | 40 |
| East Helena | 1,200 | 2 | 14 |
| Fairfield | 800 | 1 | 10 |
| Geraldine | 400 | 1 | 5 |
| Jordan | 650 | 1 | 4.4 |
| Opheim | 400 | 1 | 7.5 |
| Plentywood | 1,500 | 2 | 30 |
| NEBRASKA | | | |
| Ceresco | 325 | 2 | 1.55 |
| Greenwood | 365 | 2 | 3.45 |
| Lodgepole | 555 | 2 | 7.3 |
| Plymouth | 350 | 2 | 3.6 |
| Waverly | 300 | 1 | 3.35 |
| NORTH DAKOTA | | | |
| Beach | 1,350 | 2 | 20 |
| Bisbee | 320 | 1 | 13 |
| Butte | 250 | 1 | 1.75 |
| Cavalier | 1,350 | 2 | 16 |
| Center | 300 | 1 | 5 |
| Dunn Center | 200 | 1 | 4 |
| Elgin | 500 | 2 | 12 |
| Fessenden | 700 | 1 | 12 |
| Flasher | 300 | 1 | 5 |
| Flaxton | 350 | 2 | 10 |
| NORTH DAKOTA cont | | | |
| Fordville | 310 | 1 | 3 |
| Ft. Berthold Ind. Res. (1) | 240 | 1 | 2 |
| Ft. Berthold Ind. Res. (2) | 240 | 1 | 1 |
| Ft. Berthold Ind. Res. (3) | 100 | 1 | 1 |
| Golva | 160 | 1 | 2.5 |
| Hope | 350 | 1 | 10 |
| Jamestown | 10,000 | 1 | 130 |
| Larimore | 1,230 | 1 | 12 |
| Maddock | 700 | 3 | 32 |
| Max | 400 | 1 | 5 |
| Medina | 500 | 1 | 5 |
| Minnewaukan | 350 | 1 | 5 |
| Minto | 500 | 1 | 10 |
| Neche | 550 | 1 | 11.5 |
| New England | 1,000 | 1 | 15 |
| New Salem | 800 | 1 | 10.5 |
| Newton | 350 | 1 | 10 |
| Northwood | 1,000 | 2 | 16 |
| Park River | 1,400 | 2 | 32.6 |
| Plaza | 300 | 1 | 4.13 |
| Portland | 400 | 2 | 18 |
| Richardton (Ascension Abbey) | 400 | 1 | 1.2 |
| Rolette | 400 | 1 | 10 |
| Rolla | 1,100 | 1 | 15 |
| Scranton | 320 | 1 | 4 |
| Watford City | 1,200 | 2 | 15 |
| Wildrose | 400 | 1 | 10 |
| Wishek | 1,250 | 1 | 7.8 |
| SOUTH DAKOTA | | | |
| Beresford | 1,600 | 2 | 16.5 |
| Bison | 300 | 1 | 1 |
| Bonesteel | 450 | 1 | 5.4 |
| Clear Lake | 1,100 | 1 | 12 |
| Freeman | 925 | 1 | 9 |
| Gettysburg | 1,500 | 2 | 20 |
| Hayti | 400 | 2 | 5 |
| Isabel | 475 | 1 | 2.7 |
| Kadoka Winter | 500 | — | — |
| Summer | 800 | 2 | 8.2 |
| Lemmon | 2,600 | 1 | 25 |
| Murdo | 730 | 1 | 9.3 |
| New Effington | 200 | 2 | 3.7 |
| Philip | 750 | 2 | 5.7 |
| Pierre (4) | 100 to 200 | 2 | 0.88 |
| Pollock | 350 | 2 | 4.6 |
| Redfield | 2,600 | 1 | 30.2 |
| Sisseton | 2,800 | 2 | 27 |
| Wall Winter | 500 | — | — |
| Summer | 1,000 | 2 | 11 |
| WYOMING | | | |
| Casper (Air Base) | 50 | 1 | — |
| Newcastle | 4,500 | 1 | 33 |
| Osage | 300 | 1 | 1.75 |
| Pavillion | 240 | 1 | 3 |
| Sundance | 900 | 1 | 9.1 |

(S.D.)—Sewer District
(1) —Western School
(2) —Eastern School
(3) —Southern School
(4) —Oahe Dam Administration Area

ies. Organic material contained in lagoon effluents is thus stabilized within the protoplasm of living organisms, and since the majority of these organisms are photosynthetic in nature, the effect of lagoon effluent upon the oxygen content in receiving streams is usually negligible. Algae laden effluents usually increase the oxygen content of receiving waters. B.O.D. measurements of such effluents offer an unreal estimate of their nature, as algae usually deplete oxygen in sample bottles incubated in an environment quite dissimilar to natural conditions.

Algae, usually uninvolved in conventional sewage treatment, are a

very important group of organisms in typical lagoon activities. At Kearney, Neb., greatest waste removal was effected when they were most numerous and the least purification occurred when they were sparse or lacking. Algae offer a means of direct utilization of solar energy for waste reduction. Results at Kearney, Neb. indicate that algal growth, at least in heavily loaded lagoons, is largely controlled during open water seasons by variation in available solar radiation. Plankton algae are much more effective than attached or floating forms. Zooplankters and other animals usually occur and often perform a useful service in keeping algae and bacterial densities below saturation levels.

Lagoon cells operating in series afford greater reduction than single chamber units by virtue of the following sequence of events. As indicated above, sewage materials and energy discharged from the first cell are largely tied up in the bodies of a profuse growth of microorganisms. Water in the second cell, largely effluent from the first chamber, has the potential to produce only a fraction of the concentration of organisms attained in the primary unit.

Density of organisms in the effluent from the first cell naturally exceeds this capacity and they are unable to maintain a vigorous growth and therefore die off in the second chamber. They and their detritus are consumed by zooplankters, and large amounts of energy brought to the second chamber are utilized in animal life processes. Thus there is a marked decline in energy level from primary to secondary cells, and effluent from the secondary cell contains only a small portion of the energy and matter it received in organisms contributed from the primary chamber. Energy level is further reduced in a third cell, but very few situations justify treatment to this degree.

### Performance

Single chamber lagoons normally afford a degree of treatment comparable to that attained with very efficient conventional secondary treatment. During adverse weather conditions percentage waste removal may decline to the conventional primary level. At Kearney, Neb., for example, where lagoon loadings were frequently more than 10 times as great as practiced in the Dakotas, B.O.D. reduction varied from 32 to 90 per cent with the lower figure representative of winter conditions. During favorable seasons 90 per cent removal was effected with a loading of more than 1,000 people per acre. Maximum loading was 217 lb B.O.D. per acre per day and maximum removal was 173 lb per acre per day. Over favorable seasons the Kearney lagoon removed 127 lb of a mean daily B.O.D. load of 157 lb per acre, an efficiency in excess of 80 per cent.

Lagoons provide almost astounding removals of coliform-type bacteria. Dakota lagoons have shown very high reductions. The Kearney lagoon reduced median coliform MPN by 95 per cent over the entire operating period. Daily removal was frequently as high as 99.9 per cent.

Alkalinity and hardness are normally reduced during seasons favorable for photosynthesis, but may become more concentrated during winter. Nitrogen and phosphorous compounds are markedly lowered by algal activities, nitrogen being most commonly utilized in the ammonia form. Settleable solids are virtually eliminated, as are total suspended solids of sewage origin. However, suspended solids frequently show great increases with development of phytoplankton. Chlorides usually increase in concentration during winter but are otherwise little affected. The surfactant portion of synthetic detergents is but slightly reduced but phosphorous components are largely utilized by algal growths. Surfactants lower surface tension and many lagoons never develop waves or even ripples from wind action. Lack of surface disturbance does not appear to appreciably restrict circulation, especially in larger lagoons.

### Application

Lagoons are unquestionably well suited to sparsely populated areas where land is readily available at a reasonable price and where ice cover exists during extended periods of low solar radiation. They are solving sewage treatment problems of many towns in such regions at a fraction of the cost involved in treatment works of conventional design. They have also been advantageously used in areas with warmer climate and higher land valuation.

Where land cost is a significant factor, studies to determine maximum permissible loadings are very desirable. The Public Health Service plans to soon initiate studies at experimental facilities in Missouri and Ohio, in cooperation with the respective State health agencies, to more closely delineate features associated with the loading factor. Development of lagoons has proceeded largely along a practical path and few definitive design criteria for realistic loadings now exist.

Lagoons, by virtue of their low initial and maintenance costs, have accelerated the rate of pollution abatement progress in the Midwest. Many municipalities, now adequately handling their waste problems with lagoons, would still be discharging untreated wastes if they had been forced to wait until able to afford more conventional sewage treatment facilities. Satisfied city officials are enthusiastically recommending them to sister municipalities, and we know of one town that constructed its lagoon prior to completion of its sewerage system.

Lagoons are apparently fulfilling a long recognized need, and they appear to offer the best hope for early abatement of water pollution in many localities. In addition, they are making possible sanitary sewers in numerous areas where this basic public health facility was not previously feasible because of the high cost of conventional sewage treatment for villages and small towns.

## Frank Brooks is Dead

Frank M. Brooks, President and General Manager, Brooks Products, Inc., Pasadena, Calif., died October 5 after an illness of 30 days following a second heart attack. He was 64.

Frank, a "native son" of California, was born and educated in Santa Barbara. In 1912 he joined Art Concrete Works of Pasadena, Calif., manufacturers of concrete meter and valve boxes and other water works equipment. In due time he became president of the company, which later became Brooks Products, Inc., with plants established in several locations from coast to coast.

Frank Brooks was a member of the Am. Water Works Ass'n. and his was a familiar face at numerous section meetings across country. In Southern California he was well known for his activity in Pasadena's famed annual Tournament of Roses.

Frank is survived by his widow, a brother, four daughters and fifteen grandchildren.

# REPORT FROM ABROAD

## The Annual Conference of the Institute of Sewage Purification

**by JOHN FINCH**

**Mr. Finch is Manager of the Sewage Disposal Department, Slough, England. In his reports from abroad he discusses topics and opinions of timely interest. He welcomes the opportunity of replying personally to readers desiring additional information regarding subjects covered in his series.**

THE ANNUAL CONFERENCE of the British Institute of Sewage Purification, held at Harrogate, in my own county of Yorkshire, in June of this year again measured up as a highly successful function. A truly excellent paper and discussion on synthetic detergents, coinciding with the release by the Ministry of Housing and Local Governments of a report of the Committee on Synthetic Detergents, constituted the highlight of the whole Conference.

Other attractive features of the Conference included a paper by H. Mohle on the high-rate activated sludge plant at Wuppertal-Buchenhofen, and the visit to see the large Porteous process sludge heat-treatment plant under construction at Huddersfield, where it will operate on the secondary sludges from that sewage treatment plant.

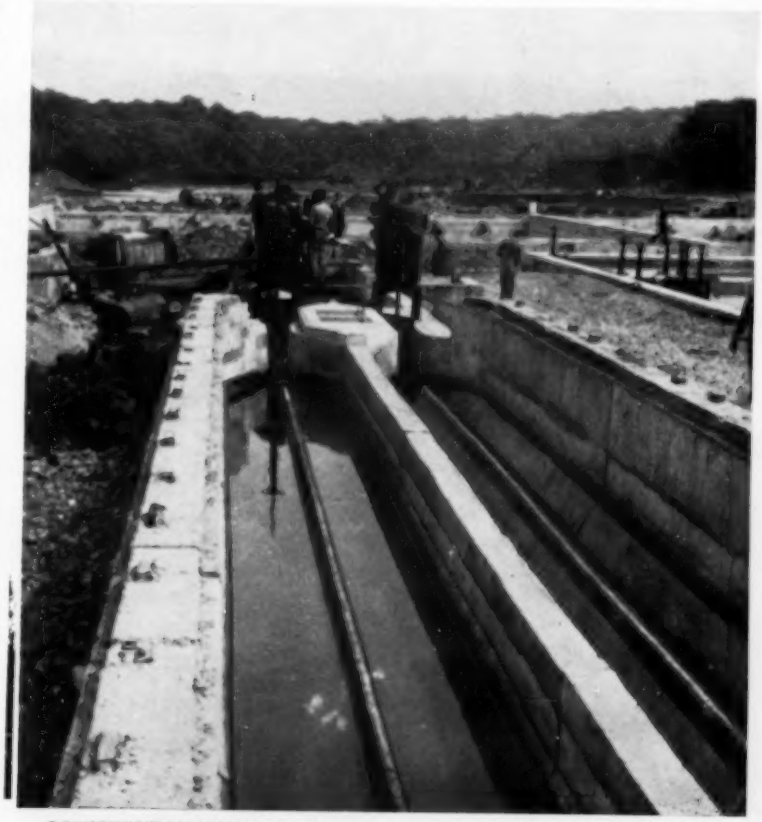
President Charles Euan Burke browsed into many aspects of sewage treatment practice during the course of his presidential address, and quoted from the address of Dr. Samuel Rideal given at the first Annual General Meeting of the British Association of Managers of Sewage Disposal Works, as follows:

> "Sewage management, and the consistent and economical production of a satisfactory effluent, is on a level with delicate manufacturing industries in requiring a special education, in this case in chemical, bacteriological and engineering knowledge; and it is in the opportunities of intercourse and the imparting of information, as well as in establishing the status and improving the opportunities of those engaged in this valuable and necessary work, that such an Association as this will have its main usefulness."

The President went on to say that there is no doubt that the sentiment expressed in that paragraph has been one of the guiding principles on the Institute through the years of its existance.

### Distillery Wastes

The paper by G. J. Jackson, of the Distillers Company Limited, on



**CONSTRUCTION VIEW of Bingley sewage treatment plant showing detritors in foreground and primary settling tanks and filters in background**

PRIMARY settling tank sludge channels at Bingley plant

"Whisky and Industrial Alcohol Distillery Wastes," was introduced by the author, who said that had the conference been held in Edinburgh it would have been possible to have arranged an inspection visit,

WIRE reinforcing of filter walls at Bingley plant

which would doubtless have put all delegates in the right "spirit".

Dr. Jackson said that certain new aspects of investigation of the problems had been revealed since the paper had been printed, and it was anticipated that some research into the treatment of the wastes by the activated sludge process would be started soon.

In his paper, Dr. Jackson stated that the treatment methods employed for the effluents from the three types of distillery wastes discussed were dictated by the degree of purification required, the volume and strength of the wastes, the space available in which the plant may be installed, the geographical position of the distillery, and the over-riding question of economics. Ease of operation and a minimum requirement for technical skill were important factors, particularly with small units in isolated areas. Unlike many industries, it was seldom possible to discharge effluents direct to the local authority sewers. Where this was possible, however, lack of space often precluded any form of pretreatment prior to discharge.

In the case of malt distilleries, purification was obtained by either percolating filters or by evaporation. Work is being carried out on percolating filters to investigate modern methods, particularly recirculation and alternating double filtration. In the case of grain distilleries evaporation is the most economic and practical method of providing complete treatment of the spent mash and it is a standard practice in the United States. The removal of insoluble solids by mechanical separation or chemical precipitation can partially reduce the pollutional load. Evaporation and incineration of the concentrate is the only practical way of carrying out the complete treatment of the wastes from industrial alcohol distilleries. Partial purification can be achieved by anaerobic digestion.

Dr. Wilson, in a very instructive contribution to the discussion on the paper, stated that in the treatment of liquors of these types it was cheaper to dilute and treat quite normally if the strength of the liquor was no more than about 5,000 ppm B.O.D., and the liquors in the group from 10,000 to 15,000 ppm B.O.D. should be digested or treated by evaporation.

### Syndets for Breakfast

As has been previously stated, the most important contribution to the Conference proceedings was the paper by W. T. Lockett, Chief Chemist to the Middlesex Main Drainage Department, on "Synthetic Detergents in Relation to the Purification of Sewage; Experiments

AND OPERATING EXPERIENCE AT THE MOGDEN WORKS." This paper coincided with the Ministry publication of the Report of the Committee on Synthetic Detergents and was, therefore, an extremely topical contribution.

The entire national daily press had given considerable publicity to the Ministry Report, in consequence of which all delegates had had syndets "a la newsprint" with their bacon and eggs. They were, therefore, in fine fettle, primed with all the facts, and "rarin' to go." Never in the history of the Institute of Sewage Purification has there ever been such a well-primed assembly.

Mr. Lockett reported how froth in noticeable proportions started to appear on the aeration tanks at Mogden in 1949, and how a manufacturer's sales drive in June 1950 increased to a very large extent the amount of suds on the same tanks. He stated that the concentration of synthetic detergents during the years 1954-6 had averaged around 7.5 ppm of active material, and had on occasion risen to 15 ppm. Sometimes the froth at Mogden had been as much as 10 feet high and had obliterated the aeration tanks. He stated that on occasions masses of foam had been carried considerable distances by wind.

In his paper Mr. Lockett noted that laboratory and large-scale investigations regarding the effects of synthetic detergents on sewage treatment processes have been carried out at Mogden, particularly relating to the diffused air process. Ill-effects arising therefrom, notably excessive production of froth and a slowing down in the rate of biological purification of the sewage, are attributed basically to the presence, in the sewage passing forward for biological treatment of synthetic detergents of the alkyl aryl sulfonate group in appreciable concentrations, and specifically to the hindrance exerted by these substances to the uptake of oxygen by the liquid in the aeration tanks from the compressed air introduced for aeration purposes, and to the inimical action of the higher concentrations of alkyl aryl sulfonates on the biological process.

Mr. Lockett continued by saying that froth may be kept well under control by treatment of the sewage to the point of advanced nitrification, and that certain anti-sudsing agents have been found to be quite effective and reasonably economic. By these means frothing at the Mogden plant has been eliminated.

Referring to the operating conditions now obtained at Mogden, Mr. Lockett said that as a consequence of the presence in the sewage of virtually unoxidizable synthetic detergents the capacity of the Mogden activated sludge plant has been reduced by approximately 20 percent.

He said, however, that one reliable means of minimizing the ill-effects of synthetic detergents on the activated sludge process is the treatment of the sewage to the point of advanced nitrification and the use of a fairly high proportion of solids in the mixed liquor.

He concluded by advocating the manufacture of biologically oxidizable synthetic detergents.

**FILTER construction at Bingley plant to handle average sewage when in use**

### Biological Filtration

A paper on "THOUGHTS ON BIOLOGICAL FILTRATION," by H. H. Stanbridge, provoked a very good discussion, as indeed it was expected to do. It was rather regretted, however, that the German delegates took no part in it, for they have carried out a very considerable amount of investigational work into the operation of the biological filter; up to very recent times, almost to the exclusion of the activated sludge process.

Mr. Stanbridge, in his contribution, discussed the mechanism of biological filtration and the principal factors affecting the performance of a biological filter. Methods of controlling the film in the filter were discussed, along with details of experiments which have been carried out to determine the optimum frequency of dosing. The paper gave a critical review of the relationship between controlled frequency dosing and alternating double filtration, and the recirculation of effluent, and it is considered that although controlling the frequency of dosing may enable the former to be dispensed with, it will help to improve the efficiency of recirculation rather than supplant it.

The author concluded his paper by making an appeal to machinery manufacturers to interest themselves in a cheap form of power drive which could be fitted to existing distributors.

The last paper, and one of the most interesting to be presented at the conference, was given by H. Mohle, of the Wupperverband, Germany, on the "HIGH-RATE ACTIVATED SLUDGE PROCESS AT THE SEWAGE TREATMENT WORKS OF WUPPERTAL-BUCHENHOFEN."

This absorbing paper described the operation of a high-rate activated sludge plant used to produce effluents of rather lower standards than are necessary in Great Britain, but made possible by the fact that these same low-standard effluents can be included in rivers where there is a large dilution factor.

The aeration plant discussed in the paper makes use of open-ended pipes or jets, and is in fact a coarse-bubble aerator of advanced design aimed at producing effluents of what might well be termed "estuarial-type" standards, and aroused a lot of interest among the delegates by its simplicity of design.

The results obtained by the application of the high-rate activated sludge process at the sewage treatment works at Wuppertal-Buchenhofen reveal great differences when compared with the common biological sewage treatment processes known so far. Great savings are stated to be possible by smaller aeration tank capacities brought about by shorter aeration times, and in respect of trickling filters by less equivalent vol-

umes, resulting in lower construction costs. In respect of biological partial treatment, air consumption and operating expenses can be reduced.

The sludges produced from these plants settle very well and are not so readily troubled by overload conditions. It is also stated that the high-rate activated sludge plant gives a great degree of reliability in operation, with simple forms of control.

### Plant Visits

Inspection trips this year were made to Huddersfield and to the Bingley sewage treatment plant; to Huddersfield to see the progress being made in the construction of the Porteous heat treatment plant for the treatment of the sludge, which plant must, when completed, be the largest unit of this type in the country; and to Bingley to see the recently constructed straight filter scheme dealing with a sewage which would be classed as about average, and certainly not stronger than average.

The Huddersfield authority has been faced with an unusual sludge disposal problem, particularly as the sewage—and the sludge—contains considerable proportions of industrial wastes. Indeed, it is stated in the paper by Dr. Goldthorpe, describing the sewage treatment plant, that domestic sewage accounts for no more than about one-third of the total volume of sewage reaching the works (and probably less than one-third in terms of pollutional load).

It is anticipated that the Porteous plant will not be operating in much less than about a year from now, and many technical workers in the sewage field will be greatly interested in the manner in which the unit will deal with the Huddersfield sludge with its heavy industrial waste component.

The population of the Country Borough of Huddersfield is about 133,000 and the daily average dry-weather flow to the sewage treatment plant is around 12.7 mgd. However, due to the five-day week and the relatively large amount of trade waste, the average dry-weather flow on the working days is about 15 mgd. The scheme includes the Haworth system of bio-aeration, and percolating filters.

Three types of sewage sludge are produced on the sewage treatment plant, as follows:

1. The primary sludge from the acid precipitation of the domestic and textile sewages yields a greasy sludge, from which grease and fertilizer are recovered as by-products in a heated sludge drying and solvent extraction plant, and amounts to about 60,000 tons (90 percent water) per year.

2. The chemical sludge precipitated by lime from the chemical sewage is at present pumped to lagoons. It has a high iron content and when alkaline can be pressure filtered to a hard cake in a few hours. The average production is 50,000 tons (90 percent water) per year. (It should be stated that separate sedimentation is given to the domestic and textile sewage, and the chemical sewage, which arrive at the sewage treatment plant by separate sewers).

3. The biological sludges from the bio-aeration plant and the percolating filters amount to an average 30,000 tons per year at 95 percent water content.

## FIFTH ANNUAL WATER WORKS MANAGEMENT SHORT COURSE

The above photograph was made of the "1956 Class" attending the Fifth Water Works Management Short Course, given by the Extension Division of The University of Illinois and sponsored by the Illinois Section of AWWA through the Section's In-Service Training Committee. This course is selective in a way, the attendance being restricted to 40, thus accounting for the relative smallness of the group. The course has been held for the past five years at "Allerton House," the University's Conference Center near Monticello, Ill. General Chairman for the courses has been Dr. T. E. Larson, Head of the Chemistry Division, Illinois State Water Survey, Urbana, Ill.

Lectures given at the three day Short Course (Nov. 14-16) were the following, after which round-table discussion was featured.

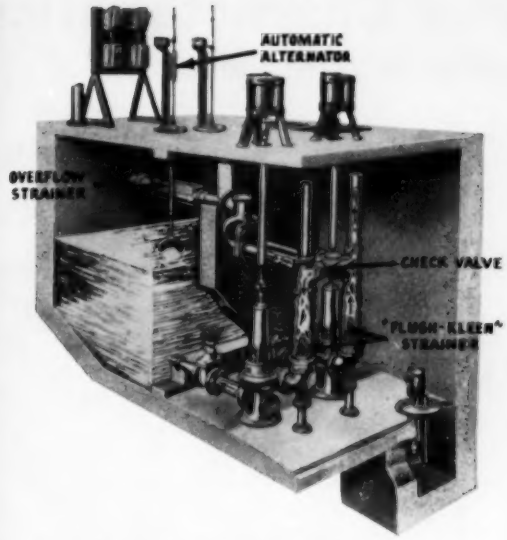
"Creative Thinking and Brainstorming"—M. G. Parsons, Bureau of Business Management, Univ. of Illinois.
"Labor Relations in Public Utilities"—J. H. Boyd, Personnel Supervisor, Illinois Bell Telephone Co.
"Developing Management Skills"—I. L. Heckman, Asst. Prof. of Management, Univ. of Illinois.
"Customer Relations in the Water Works Business"—S. C. Casteel, Manager, East St. Louis and Interurban Water Co.
"Effective Public Speaking"—L. W. Olson, Instructor in Speech, Univ. of Illinois.
"Building Morale and Maintaining Discipline Among Water Works Personnel"—T. W. Edwards, Lecturer, Div. of Extension, Univ. of Illinois.

"from Chicago"

# the Widest Range of TOP QUALITY PUMPS FOR SEWAGE AND SLUDGE HANDLING

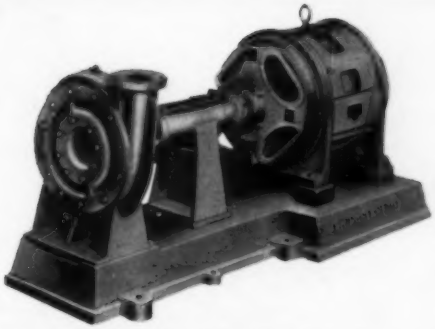
**DESIGNED**
**for specific operation**

**CHOSEN**
**for performance**



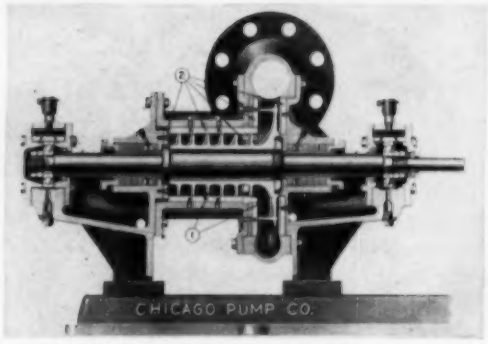

**FLUSH-KLEEN® SEWAGE EJECTORS**

Flush-Kleen sewage ejectors can't clog because rags never reach the impeller. Specially designed strainers in the discharge line retain all coarse matter. Sewage flows over the strainer and through one of the pumps to the wet well. When the pumps operate alternately they pump only strained sewage. No rags or coarse material ever pass through the pump casing. Each strainer is automatically flushed clean during its pumping cycle.



**SP-5 SEWAGE AND SLUDGE PUMP**

Specifically designed to operate at heavy duty, high head application in handling of raw sewage and all types of sludge, the SP-5 is recognized as unique among sewage equipment. By design it is particularly adapted for pumping sewage or sludge over long distances. For this service the SP-5 has been tried and proven successfully over a period of more than fifteen years.




**SCRU-PELLER® SLUDGE PUMPS**

Scru-Peller pumps are designed specifically for pumping primary sludge, are positive in operation and truly clog-proof. Continuous multiple shearing action is provided by stellited cutting edges of the screw and eight stellited cutting bars positioned in the screw and pump housings. Heavy-duty ball bearings at each end of the screw and impeller shaft eliminate strain and vibration, permitting pump to withstand sudden and severe overload shocks.

always specify "Chicago"

fmc

**CHICAGO PUMP COMPANY**

Subsidiary of Food Machinery and Chemical Corporation

**SEWAGE EQUIPMENT DIVISION**

621 DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

Flush Kleen ®, Scru-Peller ®, Plunger, Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers, Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Barminutor ®, Comminutors

# Flow Characteristics

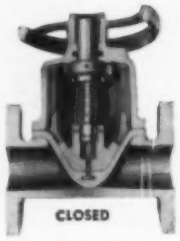
## similar to gate valves

- Streamlined straight-through flow
- Minimum pressure drop
- Handles viscous materials without stoppage
- May be rodded or brushed

# Advantages

## of a diaphragm valve

- Positive closure even with gritty or fibrous materials
- No pockets to trap sludge
- Bonnet mechanism completely isolated from fluid in line
- Completely self-draining
- Simple maintenance




## GRINNELL-SAUNDERS
## STRAIGHTWAY
## DIAPHRAGM VALVE

For handling viscous materials, slurries, sludges, solids in suspension, sewage and corrosive chemicals, Grinnell now offers a valve which has all the advantages of a diaphragm valve with the added benefits of straight-through flow.

The Straightway Diaphragm Valve* is made in sizes from ½" to 8", screwed, flanged or butt weld ends, either handwheel or power operated.

A variety of body, lining, and diaphragm materials are available to meet practically all requirements. Descriptive folder gives all details.

*Patented

GRINNELL
WHENEVER PIPING IS INVOLVED

GRINNELL COMPANY, INC., EXECUTIVE OFFICE
230 West Exchange St., Providence, R. I.
Branch Offices in Principal Cities

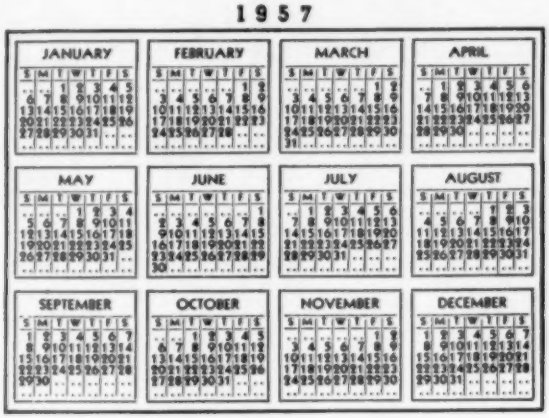

W & SW

# Meetings Scheduled

### 1956

Dec. 20—Boston, Mass. (*Hotel Statler*)
NEW ENGLAND WATER WORKS ASSN. monthly meeting. Joseph C. Knox, Secy., 73 Tremont St., Boston, Mass.

### 1957




Jan. 17-18—New York City, N. Y. (*Hotel Belmont Plaza*)
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSN., Exec. Secy. R. C. Sweeney, State Dept. of Health, 21 North Broadway, White Plains, N. Y.

Jan. 24-26—Clemson, South Carolina (*Clemson College*)
ANNUAL SHORT SCHOOL FOR WATER & SEWAGE, T. P. Anderson, Secy.-Treas., S.C. Water & Sewage Works, Assn., Wade Hampton Office Bldg., Columbia, S.C.

Jan. 29—New York, N. Y. (*Park Sheraton Hotel*)
NEW YORK SECTION, A.W.W.A., Mid-winter Luncheon; Secy., Kimball Blanchard, Rensselaer Valve Co., c/o Ludlow Valve Co., 11 W. 42nd St., New York, N. Y.

Jan. 31-Feb. 1—Wilmington, Calif. (*Los Angeles Harbor Junior College*)
6th ANNUAL INSTRUMENT SHORT COURSE, Secy. J. R. Wilson, 640 Fillmore Street, Fillmore, Calif.

Feb. 6-8—Indianapolis, Indiana (*Sheraton-Lincoln Hotel*)
INDIANA SECTION, A.W.W.A., Secy., Robert J. Becker, Indianapolis Water Co., 113 Monument Circle, Indianapolis 6, Ind.

Feb. 18-22—Jackson, Miss.
AMERICAN SOCIETY CIVIL ENGINEERS, Exec. Secy., W. H. Wisely, 33 W. 39th Street, New York 18, N. Y.

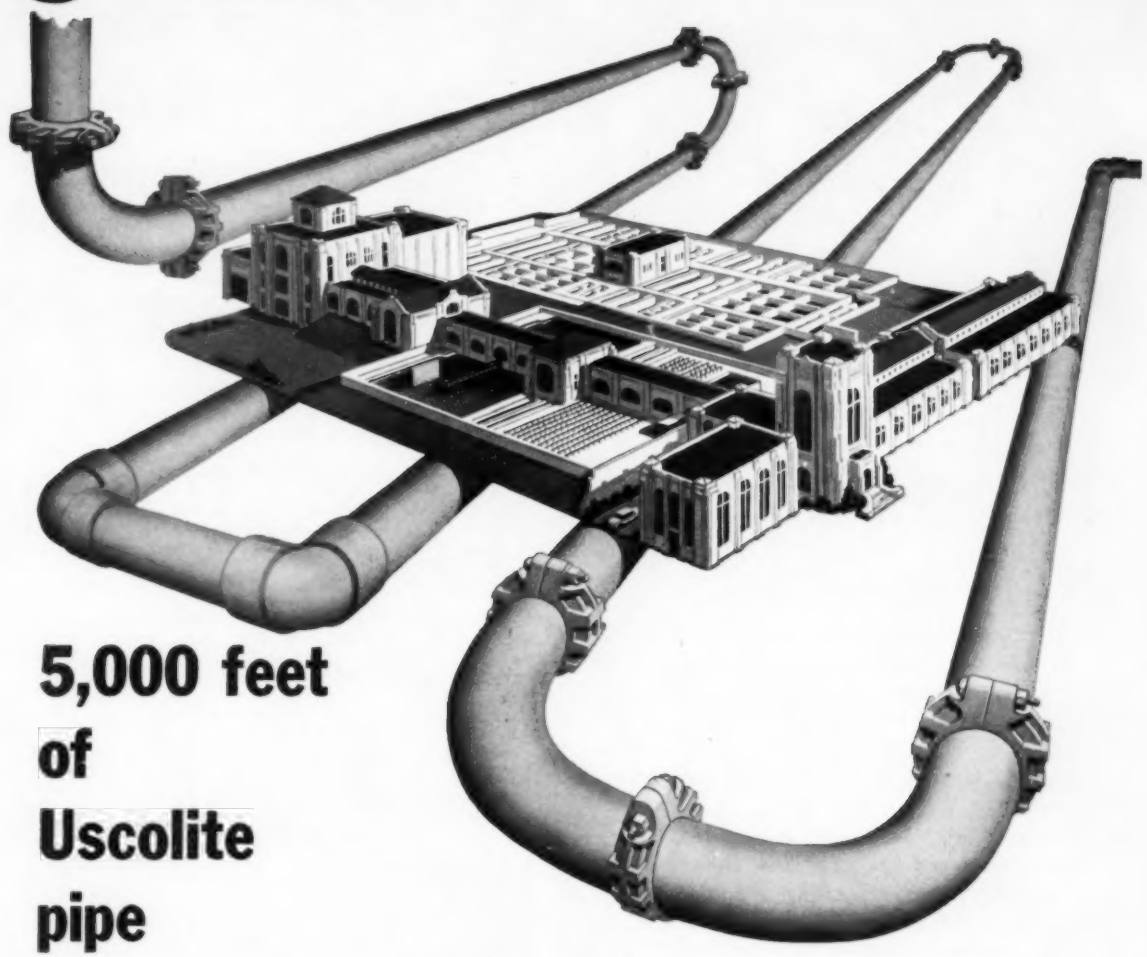
Mar. 3-8—College Station, Texas (*Texas A. & M. College*)
TEXAS WATER & SEWAGE WORKS ANNUAL SHORT SCHOOL, Secy., V. M. Ehlers, 2202 Indian Trail, Austin 3, Tex.

Mar. 5-9—Washington, D. C. (*Shoreham Hotel*)
AMERICAN CONCRETE PIPE ASSN., 49th Annual Convention; Howard F. Peckworth, Managing Director, American Concrete Pipe Assn., 228 N. LaSalle St., Chicago 1, Ill.

Mar. 13-15—Atlantic City, N. J. (*Traymore Hotel*)
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSN., Michael S. Kachorsky, Secy-Treas., P. O. Box 68, Manville, N. J.

Mar. 17-20—Charleston, S. C. (*Francis-Marion Hotel*)
SOUTHEASTERN SECTION, A.W.W.A., Secy. N. M. deJarnette, Div of Water Pollution Cont., State Dept. of Pub. Health, 245 State Office Bldg., Atlanta 3, Ga.

USCOLITE PIPE



# 5,000 feet of Uscolite pipe

## in the chlorination lines of Fort Wayne's new water-filtration plant

One of the most modern installations of its kind in the world is the new water-filtration plant of the Fort Wayne City Utilities. As part of its modernization program, it required an extensive system of new chlorine solution lines—lines that would be corrosion resistant and absolutely non-contaminating. So they chose Uscolite® plastic pipe—5,000 feet of it. It is used to carry chlorine solution and a phosphate solution.

Uscolite piping is resistant to acids, salts, alkalies and gases—both inside and out. It is non-toxic, imparts no odors and gives unimpeded flow at all times. Despite its great impact strength, it is amazingly light in weight. It is easy to cut and thread with standard equipment.

The complete Uscolite line—it includes elbows, tees, flanges, couplings, reducing bushings, caps, valves—is obtainable at any of our 28 District Sales Offices, each staffed with factory-trained engineers, or at selected "U. S." distributors. Or write us at Rockefeller Center, New York 20, New York.

National Sanitation Foundation seal of approval awarded to Uscolite Pipe.

*Watch NCAA football, Saturday afternoons, NBC TV*

Mechanical Goods Division

**United States Rubber**

# Plastic Coating Stops Costly Condensation Drip and Rust

THE COSTLY PROBLEM caused by dripping from this sweating pipe was permanently solved with one easy and inexpensive application of NoDrip Plastic Coating. Sweating pipes, ceilings, air ducts and other metal equipment are also completely protected against rust and corrosion by low cost NoDrip.

NoDrip Plastic Coating acts immediately to insulate and protect. One application adds many years of service life to metal equipment. NoDrip is also resistant to acid, alkali and brine...protects concrete, brick, plaster, tile wood or composition surfaces.

Easy application requires no special equipment or skill. Anyone can apply NoDrip with brush, trowel or spray. Stop your condensation problem now! Get full details without delay.

JW Mortell COMPANY

FREE **32-PAGE NoDrip DATA HANDBOOK**

Complete with photographs, charts and technical information to solve your condensation problem. Write today.

Available at leading plumbing and mill supply houses

J. W. MORTELL CO., 599-L Burch St., Kankakee, Ill.

Please send my FREE copy of the NoDrip Data Handbook.

Name_____

Company_____ Title_____

City_____ Zone____ State_____


Mar. 18-20—Little Rock, Ark. (*Marion Hotel*)
ARKANSAS WATER & SEWAGE CONFERENCE, C. W. Oxford, Secy.-Treas., University of Arkansas, Fayetteville, Ark.

Mar. 20-22—Chicago, Ill. (*LaSalle Hotel*)
ILLINOIS SECTION, A.W.W.A., Secy., Dewey W. Johnson, Cast Iron Pipe Research Assn., 122 S. Michigan Ave., Chicago 3, Ill.

Mar. 20-22—Baton Rouge, La. (*Louisiana State University*)
20th ANNUAL SHORT COURSE FOR WATER & SEWAGE SUPTS. & OPERATORS, Secy. George H. West, P. O. Box 15, Lake Charles, La.

Apr. 4-5—Pullman, Wash. (*State College*)
8th ANNUAL PACIFIC NORTHWEST INDUSTRIAL WASTE CONFERENCE, Technical Extension Services, State College of Washington, Pullman, Wash.

Apr. 4-6—Mesa, Arizona (*Maricopa Inn*)
ARIZONA SECTION, A.W.W.A. AND ARIZONA SEWAGE & WATER WORKS ASSN., Joint Meeting, Secy., H. C. Biggle-stone, Board of Fire Underwriters of Pacific, 1106 Luhrs Tower, Phoenix, Ariz.

Apr. 5-6—Great Falls, Montana (*Rainbow Hotel*)
MONTANA SECTION, A.W.W.A., Secy., Arthur W. Clarkson, State Board of Health, Helena, Montana

Apr. 10-12—Wichita, Kansas (*Broadview Hotel*)
KANSAS SECTION, A.W.W.A., Secy., Harry W. Badley, Neptune Meter Co., 119 W. Cloud St., Salina, Kansas
(*Jointly With*)
KANSAS SEWAGE & INDUSTRIAL WASTES ASSN., James F. Aiken, Jr., Secy-Treas., Dept. of Public Health, 407 City Bldg., Wichita 2, Kansas

Apr. 10-12—Elmira, New York (*Mark Twain Hotel*)
NEW YORK SECTION, A.W.W.A., Secy, Kimball Blanchard, Rensselaer Valve Co., c/o Ludlow Valve Mfg. Co., 11 W. 42nd St., New York 36, N. Y.

Apr. 24-26—Lincoln, Neb. (*Cornhusker Hotel*)
NEBRASKA SECTION, A.W.W.A., Secy., John E. Olsson, 408 Sharp Bldg. Lincoln, Neb.

May 1-4—San Diego, Calif. (*El Cortez Hotel*)
CALIFORNIA SEWAGE & INDUSTRIAL WASTES ASSN., R. J. Barletta, Secy.-Treas., 719 South Loara St., Anaheim, Calif.

May 2-4—Tacoma, Wash. (*Winthrop Hotel*)
PACIFIC NORTHWEST SECTION, A.W.W.A., Secy., Fred D. Jones, Room 305 City Hall, Spokane, Wash.

May 12-17—Atlantic City, N. J. (*Convention Hall*)
A.W.W.A. CONVENTION, Secy., Harry E. Jordan, A.W.W.A. Assn., 2 Park Ave., New York 16, N. Y.

May 22-24—Ocean City, Md. (*Commander Hotel*)
MARYLAND-DELAWARE WATER & SEWAGE ASSN., W. M. Bingley, Secy.-Treas., 2411 N. Charles St., Baltimore 18, Md.

June 3-7—Buffalo, N. Y.
AMERICAN SOCIETY OF CIVIL ENGINEERS, Exec. Secy., W. H. Wisely, 33 W. 39th Street, New York 18, N. Y.

June 12-14—Bedford Springs, Pa. (*Bedford Springs Hotel*)
PENNSYLVANIA SECTION, A.W.W.A., Secy., L. S. Morgan, Div. Engr., State Dept. of Health, Greensburg, Pa.

June 16-21—Atlantic City, N. J.
AMERICAN SOCIETY FOR TESTING MATERIALS

June 17-19—Winnipeg, Canada (*Royal Alexandra Hotel*)
CANADIAN SECTION, A.W.W.A., Secy., A. E. Berry, 72 Grenville St., Toronto, Ontario, Canada

June 19-21—Dayton, Ohio (*Hotel Miami*)
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT CONFERENCE, Ward E. Conrad, Secy.-Treas., 301 Ohio Departments Bldg., Columbus 15, Ohio

# Contractor Whips Tough Construction Job by Tandem Trenching Method

**J. A. JONES CONSTRUCTION COMPANY,** of Charlotte, used two Cleveland trenchers in tandem to set the pace on a tough construction job for a gas line between Chapel Hill and Sanford, N. C. The lead trencher, a Cleveland 95, opened the initial cut to a depth of 2 feet and the second machine, a Cleveland 110, dug the final trench to finished grade, an average of 3½ feet deep. Both cuts were 18 inches wide.

Tandem trenching permits each trencher to dig at its most effective speed range—usually more than twice the speed possible when digging to maximum depth. It also eliminates wasted road time necessary when "leap frogging" two trenchers. Tandem trenching is also a big advantage on jobs where top soil must be removed and replaced intact.

J. A. Jones made the most of the superior digging ability of his Clevelands by using them in tandem on this difficult job. Boulders, rock outcroppings, and closely spaced culverts cut across the trench line every few yards but the job moved ahead at the rate of a mile a day or better—trench dug, pipe joined and laid and back filling completed.

Good Everywhere

**THE CLEVELAND TRENCHER COMPANY**

**20100 St. Clair Avenue • Cleveland 17, Ohio**

W&SW

# Spillway

OVERFLOW FROM THE MAIN SECTION

## Pickups

From Purdue's *"Sanitary Engineering News"*
Don E. Bloodgood, Editor

A new mixing valve for use on water closets admits water to the flush box at a temperature that prevents condensation on the tank.

* * *

The Farmers Home Administration has loaned $242,100 to build a 23-mile water line in Fayette, County Kentucky, that will furnish 148 farm homes with Lexington water.

* * *

It's never wise to argue with a fool —the bystanders don't know which is which.

* * *

Phenol and other aromatics were not toxic to activated sludge in concentrations up to 500 ppm. phenol.

* * *

The bound water content of a zoogleal type of bulky activated sludge is higher than that of a sludge with low sludge volume index.

* * *

Water needs of the United States are expected to increase 73 per cent by 1975.

* * *

"We are not yet thirsty; we are not yet fighting among ouselves over water use. There is still a period that may be devoted to a mature study of the entire problem. Research and study of a matter so vital cannot be guided by partisans or vested interests, no matter how justifiable the interests may be."—John C. O'Byrne, Assoc. Prof. of Law, Univ. of Iowa.

* * *

"The effects of Atomic Bomb Blasts on Elevated Tanks and Standpipes," is now available from the Office of Technical Services, Department of Commerce, Washington, D. C., for 70c.

* * *

Of 1,532 communities surveyed, 367, representing a total population of nearly 20 million, need expanded water facilities.

* * *

Prejudice is a great time saver. It enables you to form opinions without having to get the facts.

* * *

Efforts to mass-produce algae—seen often as blue-green pond scum —as a possible food source will be supported by a $30,000 grant to the University of Texas for a three year period, by the Rockefeller Foundation.

* * *

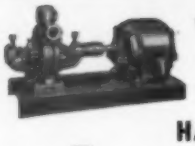
## A Safe Bet!

City Water Commissioner Frank Schwemler says he will pay $50 out of his own pocket to anyone who can drink two cents worth of Cleveland, Ohio, water in a week.

Chances are it's a safe bet. The way Schwemler figures it, two cents worth of Cleveland water is 234 gallons.


**Superb Performers**

AURORA APCO *Turbine-Type* AURORA *Always* PUMPS AURORA® *Centrifugal*



**for EVERY LIQUIDS HANDLING JOB in INDUSTRY**

The engineer-favor accorded "PUMPS by Aurora" rests squarely upon performance satisfaction. Why not let Aurora precision and quality serve your requirements, too?

ASK for CONDENSED CATALOG M-41

**AURORA APCO *Turbine-Type* PUMPS**

are available in SINGLE STAGE • TWO STAGE • FOUR STAGE • WATER JACKETED • STAINLESS STEEL or SPECIAL METALS for "1001" DUTIES.

**AURORA *Centrifugal* PUMPS**

are available in SINGLE and TWO STAGE HORIZONTALLY SPLIT CASE • SIDE SUCTION • VERTICAL • NON CLOG • SUMP • MIXED FLOW • SPECIAL DESIGN ETC.

DISTRIBUTORS IN PRINCIPAL CITIES

**AURORA PUMP** DIVISION
THE NEW YORK AIR BRAKE COMPANY
68 LOUCKS STREET • AURORA • ILLINOIS
INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N. Y.

**STOP VALVE CORROSION *...at lower cost***

For handling most corrosive fluids, there's an Ace hard rubber, rubber-lined or plastic valve that will stop corrosion failures without costing you a fortune. Check this partial list:

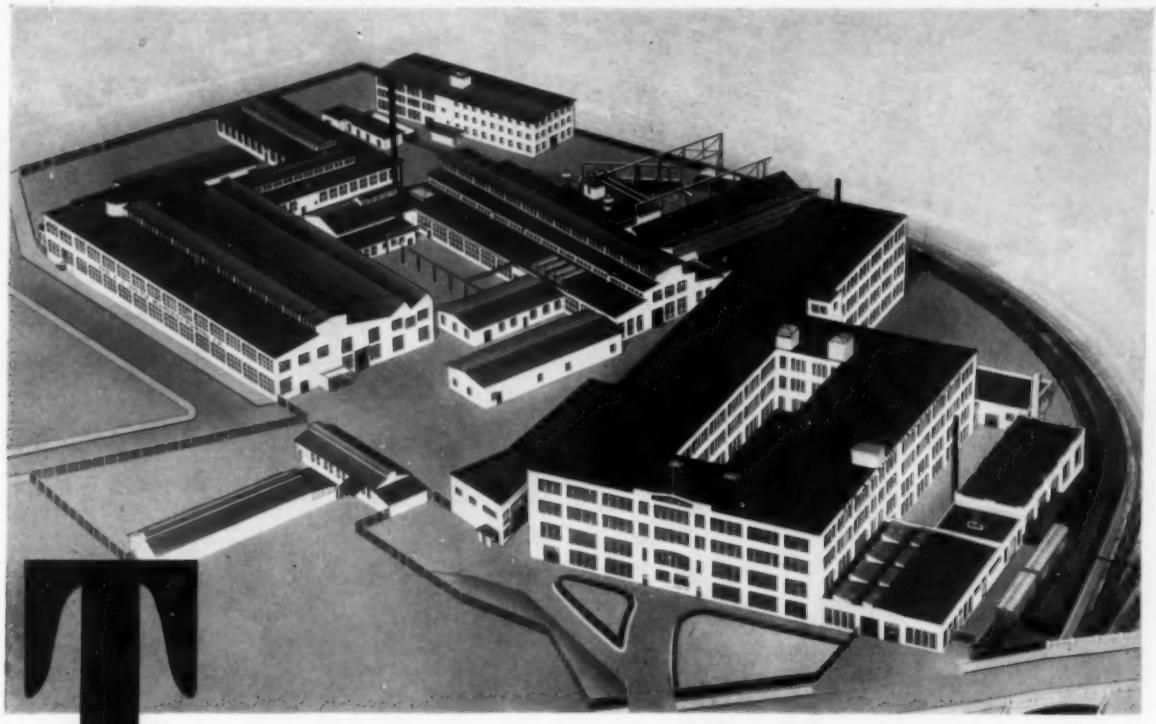
| | |
|---|---|
| Plastic Diaphragm Valves | ½" to 2" |
| Rubber-Lined Gate Valves | 2" to 24" |
| Rubber-Lined Diaphragm Valves | ½" to 14" |
| Rubber-Lined Check Valves | 2" to 24" |
| Hard Rubber Plug Valves | ¼" to 5" |

— plus bibb cocks, ball check valves, float valves, etc.

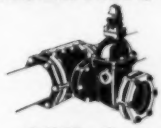
For lists of chemicals that can be handled and other details write *today* to:
AMERICAN HARD RUBBER COMPANY
93 Worth St., New York 13, N. Y.

*Manufacturers of quality rubber and plastic fluid-handling and processing equipment since 1852*

**ACE rubber and plastic processing equipment** • SINCE 1852



# THE A. P. SMITH MANUFACTURING CO.

produces, **FIRE HYDRANTS A. W. W. A. Specification and High Pressure — Compression Type — Dry and Wet Barrel Types.** **GATE VALVES sizes 2" thru 66", Manual, Hydraulic Cylinder, Electric Motor Operated for Low, Medium and High Pressure Service.** **INSERTING VALVES sizes 4" thru 48" for inserting under pressure.**  **TAPPING SLEEVE AND VALVES sizes 4" x 2" thru 60" x 48" for branch connections under pressure.**

FIRE HYDRANTS · VALVES · SINCE 1896

## THE A.P. SMITH MFG. CO.

EAST ORANGE . NEW JERSEY

## 1957 National Watershed Congress to be Held in Atlanta

A decision to hold a Fourth National Watershed Congress at Atlanta, Georgia during 1957 was reached by the sponsors of this national conservation affair when they met in Washington, D. C. on October 10. The dates will be September 23, 24, and 25, 1957.

Almost all the sponsors of the Congress held last September at Lincoln, Nebraska attended and indicated they would sponsor the 1957 meeting.

Waters S. Davis, Jr., Texas rancher and a former president of the National Association of Soil Conservation Districts will continue as Chairman.

The selection of Atlanta as a meeting place relates to the decision made two years ago to hold this annual meeting in a different part of the nation each year. There was some discussion on October 10th that the 1958 Congress might be held on the west coast.

Views expressed at the sponsors' meeting in Washington call for the 1957 Congress to place attention on pollution abatement, municipal water supply and recreation as well as state water laws and federal participation in watershed development under the Watershed Protection Act.

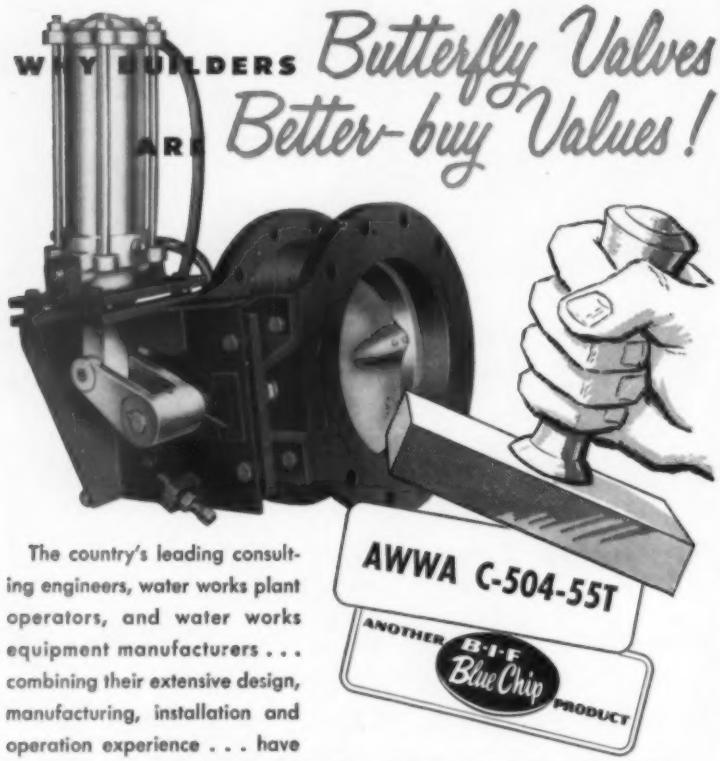
## "Bill" Lybrook Passes

W. M. Lybrook, for some years Director of Public services, Greensboro, N. C. died suddenly on Sept. 11, 1956.

"Bill" Lybrook a graduate of Virginia Polytechnic Institute, had long been connected with the Greensboro Water Dept. He was an Active member of AWWA's N. Carolina Section and the N. C. Sewage Works Assn.

As Director of Public Service, Lybrook had charge of both water supply and sewage disposal. He is being succeeded by T. Z. Osborne, formerly Ass't. Director of Public Services.


WHY BUILDERS Butterfly Valves ARE Better-buy Values!



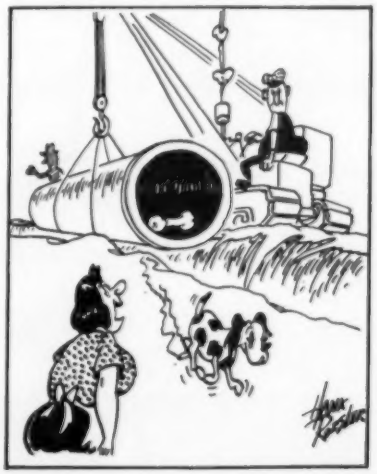

The country's leading consulting engineers, water works plant operators, and water works equipment manufacturers . . . combining their extensive design, manufacturing, installation and operation experience . . . have prepared exacting specifications for rubber-seated Butterfly Valves. BUILDERS-PROVIDENCE Butterfly Valves conform to these specifications and offer the following superior features:

- √ Extra-rugged body construction.
- √ Extra large diameter, stainless steel shafts.
- √ Heavier, larger, longer bearings reduce unit bearing load.
- √ Heavier, sturdier vanes.
- √ Operators matched to valve . . . to meet job torque requirements and *minimum* AWWA Specs.

Builders Butterfly Valves fully comply with AWWA STANDARDS to make them BETTER-BUY VALUES. Request Bulletin 650-L1. Write to BUILDERS-PROVIDENCE, INC., 350 Harris Ave., Providence 1, R. I. . . . division of

B-I-F INDUSTRIES
PROVIDENCE, RHODE ISLAND
METERS FEEDERS CONTROLS

BUILDERS-PROVIDENCE, INC. • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

**"Yeah! ever since you guys started laying pipe he's found out that he don't have to work no more to get his bones buried."**

# "We're doomed, Orgie, PITTCHLOR® is the favorite!"

That's right, Orgie. Users everywhere who employ Pittchlor for water and sewage treatment know its speed and effectiveness in killing chlorine-susceptible bacteria and algae.

Pittchlor kills microorganisms on contact because it is a stable, high-test calcium hypochlorite containing a minimum of 70% available chlorine. Economical and convenient to apply, Pittchlor is excellent for chlorinating water supplies, treating sewage or wherever the germicidal and deodorizing action of chlorine is needed.

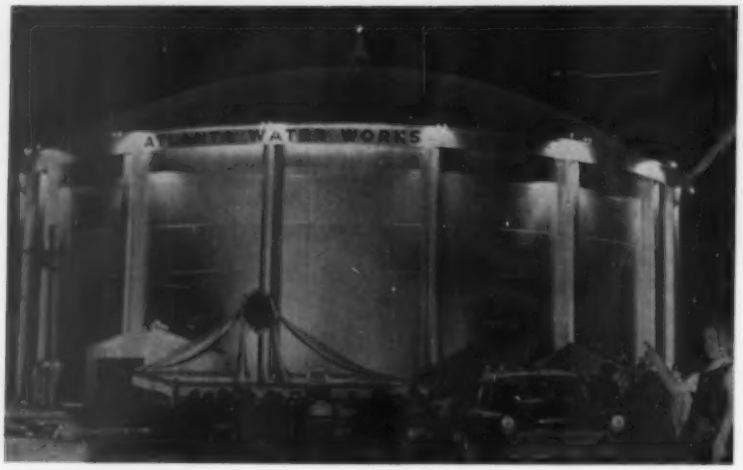
Pittchlor is dry, white and free-flowing. Its granular form permits ease of application either manually or by mechanical feeders. Write for free folder.

**For water purification, sewage treatment, and swimming pool sanitation**

**Stocked by leading jobbers in 5 lb. resealable cans (9 per case), 3¼ lb. cans (12 per case) and 100 lb. drums.**

**COLUMBIA-SOUTHERN CHEMICAL CORPORATION**
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

DISTRICT OFFICES: Cincinnati • Charlotte Chicago • Cleveland • Boston • New York • St. Louis • Minneapolis • New Orleans • Philadelphia • Houston Pittsburgh • Dallas • San Francisco
IN CANADA: Standard Chemical Limited and its Commercial Chemicals Division



## Atlanta's Newest Distribution Reservoir

The above picture was made on the night of Oct. 5th during the dedication of Atlanta's newest water distribution reservoir, known as the Adamsville Reservoir which will serve a remote area recently annexed. Atlanta has a slogan.

"Where Water Goes: Atlanta Grows!"—This new ground reservoir and pumping station fits in with that slogan.

The tank holds 5 million gallons. It fills during the night and discharges through the automatic pump station during hours of daytime demand. It was financed through a revenue certificate issue, which was justified on the basis of increase in water sales revenue plus insurance cost reduction in the area served. In addition domestic and commercial service is materially improved.

The tank is 140 ft. in diameter and 46½ ft. high. Its contruction involved 800 tons of steel, a 400 ton concrete foundation, a 1200 ton oiled sand cushion, 25 tons of enamel lining and 450 gals. of exterior paint.

The project cost $400,000 for the tank and foundation; $150,000 for the pumping station and another $150,000 for pumps, valves, fittings, instrumentation and automatic controls. The total cost will be something more than $750,000 which represents money borrowed from the city and repaid from water sales income—a "pay as you go" plan.

## TV Sets Now Outnumber Bathtubs in American Homes

From an authoritative source it is stated that there are now more television sets than bathtubs in American homes. This same report states that 49,000,000 TV sets have been manufactured during the last eight years. It is estimated that TV viewers spend 2,600,000,000 hours per week watching TV programs.

Considering all of this, possibly our way to reduce water use per capita would be to promote the sale of TV receivers and bigger and better programs.


# "FLEXIBLES" Control Capetown's Unique Sewer Problem!

**Progressive Capetown, South Africa, in addition to 925 miles of sewers and storm drains to maintain, has unique, special problems in its picturesque Table Mountain area.**

**Five huge 2800 foot long culverts are required to dispose of tremendous peak flows from the mountain slopes, and also accommodate a perennial fresh water stream flowing into the Cape of Good Hope. Over 30,000 cubic feet of silt and debris must be removed from these culverts each year.**

**Meeting its needs *modernly*, the City Engineering Department has wisely equipped itself with a fleet of eight "Flexible Bucket Machines". The machine shown "on the job" is the first unit purchased in 1948—*still going strong*.**

**FLEXIBLE INC.**

3786 Durango Ave., Los Angeles 34, Calif.

(Distributors in Principal Cities)

# WHEN RED WATER DISAPPEARED...

## complaints turned to compliments

In a pleasant western community of about 40,000 population, constant complaints about red water made life miserable for the water superintendent. All that has changed, now that Calgon is on the job. In fact, he tells us "Perfect strangers stop me in the street to compliment me on the crystal clear water this community now enjoys."

Red water has stopped because Calgon* Threshold treatment stablizes iron and manganese dissolved in well water at its source. The red (or black) water problem is licked, and the capital expenditure for a costly iron removal plant avoided.

Calgon is the easy and *economical* way to keep your citizens or customers happy if your well water supply contains iron or manganese.

Calgon engineers with experience in all types of water problems in all parts of the country are at your service. A letter or phone call will put a Calgon engineer to work on your water problem.

*Calgon is the Registered Trade Mark of Calgon, Inc. for its glassy phosphate (Sodium hexametaphosphate) products.

**calgon, inc.**

**A SUBSIDIARY OF HAGAN CORPORATION**

**HAGAN BUILDING • PITTSBURGH 30, PA.**

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

W&SW

# New Equipment

## Piston-Type Oil Pump For Vertical Shaft Machines

**1201**

Bijur Lubricating Corp., Rochelle Park, N. J., has developed a new piston pump that has only one moving part, for the continuous lubrication of a bearing or series of bearings.

Described as a rotating pump with an oscillating piston, the new unit consists of a cylindrical housing containing a horizontal stepped piston. It is designed primarily for lubrication of machines with a vertical drive shaft, and is attached directly to the bottom of such shaft. The pump is mounted so that it rotates in a fixed eccentric race in a sump, and the ends of the piston, extending beyond the diameter of the housing, ride against the eccentric race. The resulting oscillating action of the piston draws oil into the pump and feeds it under pressure into the bore of the drive shaft and thence to the bearings.


M H Class 250

M & H Gate Valves, Class 250, are similar in design, workmanship and materials to standard A. W. W. A. Class C valves, except the Class 250 valve is designed for higher operating pressures and is therefore heavier in weight. Class 250 valves are available in 14"-36" sizes, are iron body, bronze mounted, double disc, parallel seat, non-rising stem or outside screw and yoke. All valves of this class are given an hydrostatic test of 450 psi.

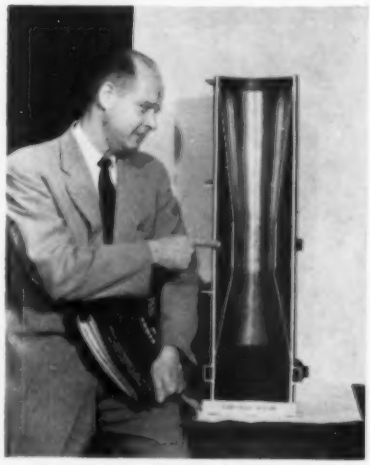
Class 250 valves are furnished with either hub or flanged end connections. Dimensions and drilling of end flanges conform to American Cast Iron Flange Standard, Class 250. Can be furnished with plain faced flanges if desired, also with standard accessories such as hydraulic or motor operation, gearing, bypasses, square bottom, extension stems and rollers-tracks-and-scrapers. Write or wire

M&H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA


## New Fabricated Venturi Tube

**1202**

Penn Instruments Division, Burgess-Manning Co., Philadelphia, Pa., has developed a new fabricated Venturi Tube, called type PVF,



designed to replace standard cast iron or plate steel tubes.

Some of the advantages claimed for the new tube are; light weight compared with cast iron tubes, ability to maintain close manufacturing tolerances, relatively quick deliveries, and a decided price advantage.

The tube is readily adaptable for a variety of end fittings and, may be equipped with welded or slip-on flanges. It also may be furnished with welding or bell and spigot ends, or may be used with mechanical type couplings.

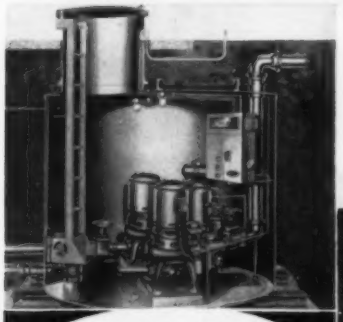
If desired for sewage or sludge

(*Continued on page 94A*)

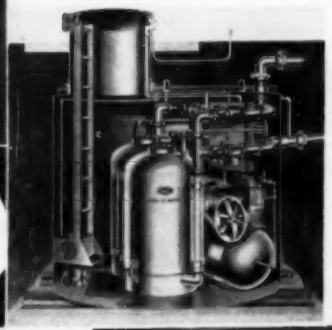
# Smith & Loveless
## BUILDS FIVE (5) SEWAGE LIFT STATIONS FOR INDIANOLA, MISSISSIPPI

When bids were received for a sewer system at Indianola, Mississippi the cost of five (5) concrete lift stations exceeded the available funds.

To reduce the cost of these stations the consulting engineers, Ewin Engineering Corporation of Mobile, Alabama, prepared new plans and specifications for factory-built lift stations as manufactured by Smith & Loveless, Inc.



**ALL S&L PRODUCTS ARE PERMANENTLY PROTECTED WITH "VERSAPOX"**

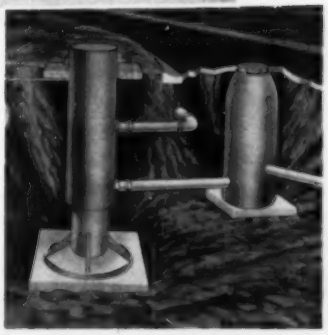


The Indianola lift stations recently installed are of both pump and ejector types as follows:

ONE — 8′ diameter duplex pump station with 600 G.P.M. pumps.

TWO — 8′ diameter "Way-O-Matic" duplex pneumatic ejector stations with 100 G.P.M. ejectors.

ONE — 9′-6″ diameter "Way-O-Matic" duplex pneumatic ejector station with 200 G.P.M. ejectors.



ONE — 4′ diameter "Mon-O-Ject" single pneumatic ejector station with 40 G.P.M. ejector and stand-by motor, compressor and controls.

Hundreds of cities are reducing costs with Smith & Loveless "proven quality" lift stations.

For job recommendations, complete specifications and drawings—all part of the latest edition of the 100 page Smith & Loveless lift station Data Manual . . .

**WRITE DEPARTMENT 20**

**S&L Smith & Loveless, Inc.**
P.O. BOX 8172 KANSAS CITY, MISSOURI
PLANT: MERRIAM, KANSAS
REPRESENTATIVES IN PRINCIPAL CITIES

the tube may be equipped with manually operated cleaning valves at the main and the throat, or may by used with continuous back purging devices.

The new tubes conform to conventional Venturi dimensions, and are offered in sizes ranging from 6 to 96 inches in diameter. The entire inner formed section is constructed of stainless steel, and the surrounding pipe section may be constructed of carbon or stainless clad steel pipe. A single or multiple tap design may be employed.

## Continuous Monitoring Turbidimeter

**1203**

Kaye Development Company, Cambridge, Mass., has developed the Turbistat, an instrument which provides continuous monitoring of turbidity in fluids. It is based on a dual beam system whereby light scattered by suspended particles is compared with light transmitted by the fluid.

A special servo system maintains the unit's optical balance at all times, eliminating drift and error due to lamp aging, line voltage variations, deposits on windows, temperature changes or gain instability.

Suspension as low as 0.05 parts per million of diatomaceous earth in water can be measured, with full scales as high as 250 ppm. Unit can be coupled to a side stream or used directly in any stream up to 3 inches in diameter, and to pressures up to 500 psi.

## Nomograph for Preparing Activated Silica Sol

**1204**

Philadelphia Quartz Company, Philadelphia, Pa., has just issued a chart suitable for posting which eliminates mechanical calculations when reacting sodium silicate with sulfuric acid, ammonium sulfate, alum, sodium bisulfate, bicarbonate, carbon dioxide, chlorine or other acid functioning chemicals. Directions tell how to use the chart which correlates flow rate and silica dosage with sodium silicate requirements, quantity of reacting chemical, dilution volumes, expected alkalinity of some preparations and feed rate of silica sol for flow variations.

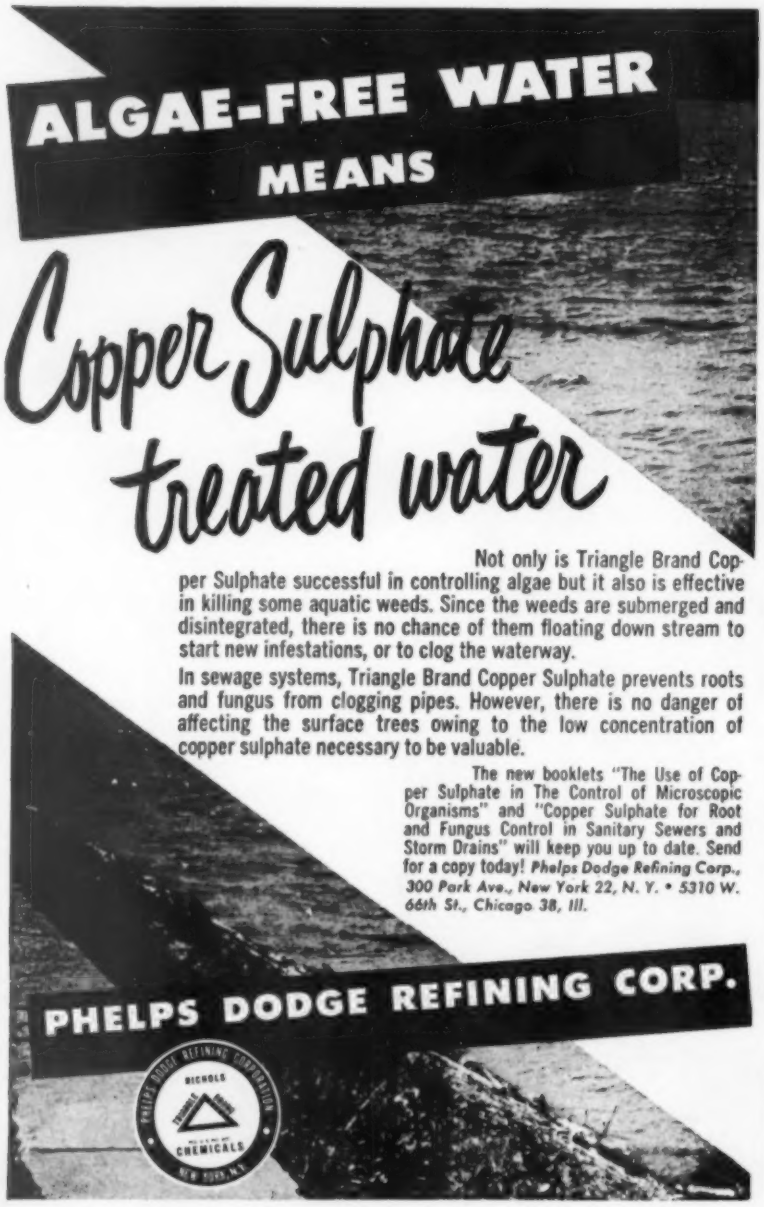
## New Proportioning and Metering System and Equipment

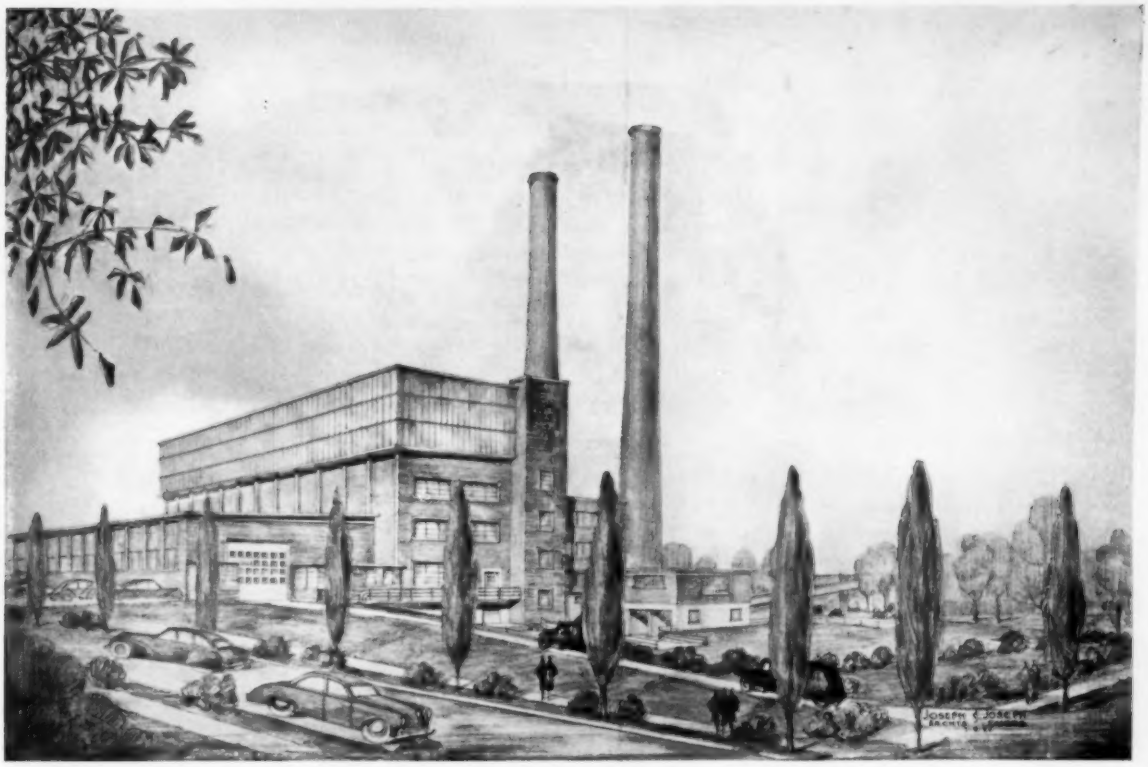
**1205**

Infilco Inc., Tucson, Arizona, has developed a new "ATI" proportioning and metering system that provides an overall accuracy of 2% plus or minus over range of flow from 100 to 10% of rated capacity for equipment used.

Advantages of the new "ATI" proportioner are: It can be used to maintain chemical feed in proportion to flow; affords a measurement of flow on the linear scale; requires no electrical connections in the venturi pit or pipe gallery; allows the transmitter to be installed at any distance up to 500 ft. from the differential producer; uses a transmitter which is not connected to the liquid flow; and is reliable and accurate, requiring very little maintenance.

The system will record, indicate or totalize the flow, or combine any two or all three of these functions. Also the meter case may be mounted on wall, panel or stand.


ALGAE-FREE WATER
MEANS
Copper Sulphate
treated water
Not only is Triangle Brand Copper Sulphate successful in controlling algae but it also is effective in killing some aquatic weeds. Since the weeds are submerged and disintegrated, there is no chance of them floating down stream to start new infestations, or to clog the waterway.
In sewage systems, Triangle Brand Copper Sulphate prevents roots and fungus from clogging pipes. However, there is no danger of affecting the surface trees owing to the low concentration of copper sulphate necessary to be valuable.
The new booklets "The Use of Copper Sulphate in The Control of Microscopic Organisms" and "Copper Sulphate for Root and Fungus Control in Sanitary Sewers and Storm Drains" will keep you up to date. Send for a copy today! Phelps Dodge Refining Corp., 300 Park Ave., New York 22, N. Y. • 5310 W. 66th St., Chicago 38, Ill.
PHELPS DODGE REFINING CORP.
NICHOLS
CHEMICALS



Architect's drawing of the Louisville, Kentucky refuse incineration plant—Joseph and Joseph, Architects. Not illustrated is the new Sewage Treatment Plant, Metcalf and Eddy, Engineers.

# LOUISVILLE USES REFUSE TO DISPOSE OF SEWAGE SLUDGE

The City of Louisville, Kentucky is currently building a new sewage treatment plant and—several miles away—a new refuse incinerator plant.

Rather than incorporate sludge disposal facilities in the new treatment plant, the City will truck filter cake to the refuse incinerators. There, two C-E Raymond Flash Drying Systems will utilize the waste heat from the incinerators to dry the filter cake for use as a fertilizer or prepare it for burning in the incinerator with the refuse. For Louisville, this combination of facilities offers a number of advantages. Among them are—

**Least First Cost** for a system capable of drying, incinerating and deodorizing. The refuse incinerator eliminates the need of a separate drying furnace.

**Least Operating Cost** because it taps a source of "no cost" BTU's, thereby eliminating the need of purchased fuel.

**Maximum Flexibility** since the City can dry any amount of sludge for sale as a fertilizer or for use on municipal golf courses, parks and lawns. Any unused sludge can be incinerated with the City's refuse.

If you are considering new sewage disposal facilities—alone or in combination with refuse disposal, see C-E. We will be happy to discuss your needs with you and with your consultants. No obligation of course. Remember, *more filter cake is dried and/or incinerated by the C-E Raymond System than by all other systems combined.*

## COMBUSTION ENGINEERING

RAYMOND DIVISION
1315 North Branch Street, Chicago 22, Illinois

B-965

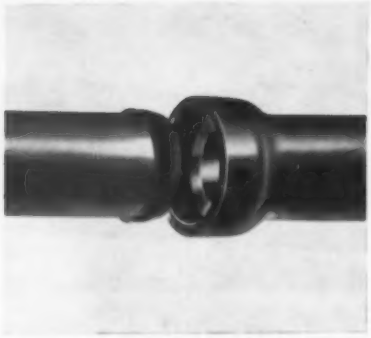
Eastern Office: 200 Madison Avenue, New York 16, N. Y. • Western Office: 510 West Sixth Street, Los Angeles 14, Cal.

ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WASTE DISPOSAL

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

## New Clay Sewer Pipe Joint

1206



W. S. Dickey Clay Manufacturing Co., Kansas City, Mo., has developed an entirely different method permanently jointing clay sewer pipe to insure a watertight, root-resistant, and flexible union.

Called the Dickey PVC (polyvinyl chloride) Coupling, it is put on the pipe at the factory under the rigid control and inspection of trained specialists. The coupling consists of rings, precision molded and fused on the spigot and in the bell of the pipe.

A joint is made by applying Dickey Lubricant Sealer to the mating surfaces of the coupling and simply pushing the spigot firmly into the bell socket. This is done by using a shovel, bar, or board as a lever.

A compression-type joint, the coupling keeps the precision mating surfaces in tight contact with each other, and exerts a pressure on the inside of the bell and the outside of the spigot, thereby increasing the bond of the coupling with the pipe.

## Eight-Scale Manometer

1207

King Engineering Corp., Ann Arbor, Michigan, has available a new 8-scale Instrument Test Manometer with a 61 inch scale length.

The scales are mounted on the sides of an 8-sided vertical drum, permitting any scale to be easily rotated into reading position beside the glass tube. Scale calibrations are in any desired units and the scale drum can be adjusted vertically through a range of 3 inches to compensate for changes in barometric presure.

The manometer has a heavy-gauge steel case and is regularly furnished with a tripod base. Other features include a special drain plug to control flow of liquid when draining, and an overflow check valve and return well to prevent loss of indicating liquid in the event of over-pressure.

## 2500 GPH Dual Column Demineralizer

1208

Penfield Manufacturing Co., Meriden, Conn., has added a new 2,500 GPH demineralizer to its line of industrial demineralizers.

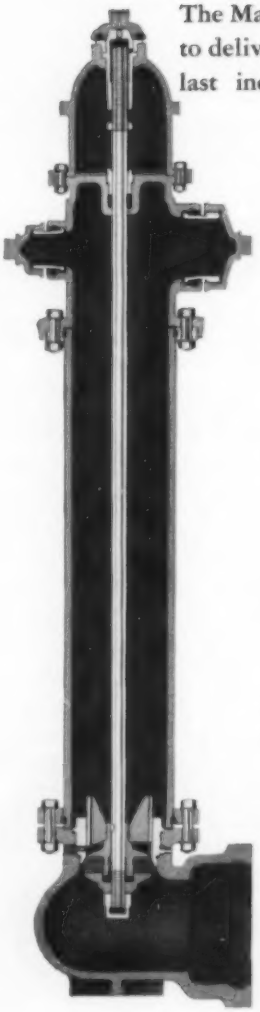
All operating functions are automatic. When the effluent's purity falls below the desired standard originally set by the operator, the unit automatically stops delivering treated water and the need for a regeneration cycle is signalled. The regeneration cycle is initiated by setting one switch and completes itself entirely automatically, including rinsing and recutting in the effluent when the pre-set standard of purity is attained.

## Multi-Tank Capacity Telemeter

1209

The Fielden Instrument Div., Robertshaw-Fulton Controls Co., Philadelphia, Pa., has available a


# Reduce Wear, Save with Mathews



**The Mathews Flange Barrel Hydrant is designed to deliver every available gallon of water and to last indefinitely with minimum maintenance.**

**CHECK THESE IMPORTANT FEATURES**

*The Flange Barrel*

The swivel flange at the base of the nozzle section permits nozzles to be faced toward any point in the complete circle. Saves time on original installation and on replacements.

On broken hydrants, top cap and nozzle sections can usually be salvaged, thus reducing accident costs.

*The Stuffing Box Plate*

Cast integral with the nozzle section, the plate keeps water and sediment away from the operating thread. Hydrant remains operable in any weather. Wear on the operating thread is largely eliminated.

**Made by**

Available with mechanical joint pipe connections.

capacity telemeter that, when connected by coaxial cable, permits the control position to be as far as 4,000 feet away.

The complete unit consists of a measuring unit, a remote probe unit for each tank, and an indicator which can be a meter, recorder or precision indicator. The size and shape of tanks using the remote system can be varied with no effect on the instrument's accuracy.

## Sump Pump

**1210**

Le Roi Division, Westinghouse Air Brake Co., Milwaukee, Wis., has developed a new, air operated sump pump. The pump is rated at 340 GPM against a 10-foot head. It is available in either steel or bronze, with the latter for use in pumping acid or corrosive liquids.

Features of the new pump, which operates with a maximum head of 95 feet, include light weight construction, low air consumption, a governor-controlled motor, and a built-in lubrication system. It is designed for removing water or other liquids from tanks, sumps, ditches, manholes, or traps. The pump requires no priming.

**Time and Money**
**Flange Barrel Hydrant**

*Breakable Flange and Stem Coupling*

Optional feature furnished at extra cost. Specially designed flange in the standpipe just above ground level and a frangible coupling in the hydrant stem are designed to snap when struck a blow heavy enough to break the hydrant. Both can be replaced quickly *and without excavating*, while hydrant head, standpipe and stem remain undamaged.

ADDITIONAL ADVANTAGES

Two-way heads can be replaced with steamer and two-way heads without shutting off water.

Shield operating nut assures protection for the revolving nut from sleet, snow or dust.

An extension piece may be inserted between hydrant head and barrel or between barrel and elbow.

**R. D. WOOD COMPANY**

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

## Plastic Mixing Tank Chemical Cages

**1211**

Carl N. Beetle Plastics, Inc., Fall River, Mass., has developed a chemical cage made of Bonate resin that is designed to eliminate acid corrosion and wood splinter problems in sewerage treatment plants.

A test cage was installed in the Fall River sewerage treatment plant to replace the previously used wooden cages, for mixing ferric chloride. The wooden cages quickly splintered and resulted in damage to costly equipment.

Mr. Arthur Slater, Superintendent of the plant, stated that the chemical cage has shown no acid corrosion wear since its installation, and has completely eliminated the old maintenance problem caused by wood splinters.

## New Connectors for the Laboratory

**1212**

Burrell Corporation, Pittsburgh, Pa., has announced availability of a series of new connecting and valving parts for use in analytical instruments for the laboratory.

The devices avoid the conventional and time consuming methods of making rubber and metal tubing connections and offer instead a means for easily making and breaking joints, adding and removing parts and stopping or renewing the flow of gases, vapors or liquids.

Included are a group of ingeniously designed glass or metal sockets, including designs for ease of panel-mounting, neoprene and silicone seals, metal tubing, couplings and pins. All are designed for quick make and break, and convenient leak-free operation.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

GUNITE
The Modern Way...

for Repairing, Constructing, Lining:

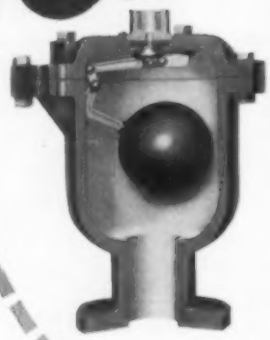
- Reservoirs • Dams
- Filter Plants • Tanks
- Sewage Disposal Plants
- Stadiums • Bridges
- Sea Walls • Swimming Pools

*Write for more information, including 48 page "Gunite" booklet.*

PRESSURE Concrete Co.
FLORENCE, ALA.
315 So. Court Street

Liberty Life Bldg. CHARLOTTE, N. C.
33 N. LaSalle Street CHICAGO, ILL.
193 Emmet Street NEWARK 5, N. J.

Crispin



AIR & VACUUM VALVES
*Finest insurance against collapsed pipes*

Crispin Air and Vacuum Valves permit air to escape as line fills and allow air to enter as line empties. Simplified design, rugged, durable construction for lasting service. One of several Multiplex Air Valves that are preferred by water works engineers for dependable and efficient control of air in pipelines.

FREE CATALOG . . .
Write for your copy of the Crispin Air Valve Catalog which contains illustrations, specifications and a list of satisfied users throughout the world.

multiplex
MANUFACTURING COMPANY
BERWICK, PENNSYLVANIA


## Ottawa Backhoe for Michigan Tractor Shovel

1213

Ottawa Steel Div., L. A. Young Spring & Wire Corp., Ottawa, Kansas, has announced that the Ottawa Big Muscle Backhoe, is now available for the Michigan 75-A Tractor Shovel.

Both the Model DX-75A Backhoe, which digs to a depth of 11 feet, and the Model EX-75A Backhoe with a 8½ ft. digging depth, can be equipped with buckets from 12" to 36" in width.

The patented automatic ejector bucket, an exclusive feature of the Ottawa Backhoe, positively ejects wet or sticky materials without loss of cycle time.

Another exclusive feature, the Ottawa One-Trol, assures fast, smooth operation by the use of only two levers to control all actions which normally require the use of multiple levers.

Power is obtained from the Michigan hydraulic system. All hydraulic cylinders are of the double acting piston type, with chrome plated rams. The Ottawa Backhoe is mounted by removing the rear counterweight.

## Pipe & Bolt Machine

1214

Beaver Pipe Tools, Inc., Warren, Ohio, has developed a new Beaver Portable Pipe and Bolt Machine. Called the "Speed-O-Matic" it is a fast, rugged, powerful machine weighing only 170 pounds. It threads ⅛" to 2" pipe, ¼" to 2" bolts, up to 12" with a drive shaft. The new, greatly improved, fully protected motor is said to give at least 50% more speed. It's more powerful and faster. The recessed motor switch is fully protected.

The new Beaver Power-Grip Wrenchless Chuck is standard equipment on the "Speed-O-Matic". Cutoff, dieheads, and reamer are all pivot mounted making it an ideal make-up machine. The new "Clear-Vu" self-centering wheel-

*New Subscription Order Card*

**NOTE THE NUMBERS**
**they correspond with the**
**headings in our**
**EQUIPMENT AND LITERATURE COLUMNS**
**To receive further information**
**on any of the listed**
**EQUIPMENT OR LITERATURE**
**just circle the corresponding**
**numbers on the card**
**Fill in your name, address, title**
**and mail!**
**For your convenience these**
**cards require no postage.**

**Water & Sewage Works**

185 NORTH WABASH AVE. CHICAGO 1, ILL.

Gentlemen:

Please enter my new subscription to WATER & SEWAGE WORKS for the period checked below:

☐ Three Years—$6.00 ☐ Two Years—$4.50 ☐ One Year—$3.00

Above rates are for U.S.A. and Canada. Add $1.50 per year for other countries.

Name _____ Title or Position _____

Company or Govt. Dept. _____

Address _____

City _____ Zn. _____ State _____

***PLEASE SEND ME INFORMATION ON THE ITEMS CIRCLED BELOW**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1201 | 1202 | 1203 | 1204 | 1205 | 1206 | 1207 |
| 1208 | 1209 | 1210 | 1211 | 1212 | 1213 | 1214 |
| 1215 | 1216 | 1217 | 1218 | 1219 | 1220 | 1221 |
| 1222 | 1223 | 1224 | 1225 | 1226 | 1227 | 1228 |
| 1229 | 1230 | 1231 | 1232 | 1233 | 1234 | 1235 |

**IF YOU WISH TO RECEIVE FURTHER INFORMATION ON PRODUCTS ADVERTISED OR REFERRED TO IN THE ARTICLES, OF THIS ISSUE—LIST THE PAGE NOS. BELOW.**

_____

_____

_____

_____

_____

Your Name _____

Title _____

Company or Dept. _____

Address _____

_____

*ITEMS LISTED NOT SERVICED AFTER JANUARY 31, 1957

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

First Class Permit No. 43608, Sec. 34.9, P.L.&R., Chicago, Ill.

WATER & SEWAGE WORKS
185 NORTH WABASH AVENUE
CHICAGO 1, ILLINOIS

Postage Will Be Paid by Addressee

# *New Subscription Card*

**for**

# WATER & SEWAGE WORKS

**JUST CLIP THESE CARDS MARK AND MAIL— TO RECEIVE THE LATEST INFORMATION OR LITERATURE DESCRIBED IN THIS ISSUE**

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

First Class Permit No. 43608, Sec. 34.9, P.L.&R., Chicago, Ill.

WATER & SEWAGE WORKS
POST OFFICE BOX 35
VILLAGE STATION
NEW YORK 14, NEW YORK

Postage Will Be Paid by Addressee

***READER SERVICE CARD for***

# WATER & SEWAGE WORKS

**Equipment — Products**
**Information — Literature**

and-roller cutoff allows the operator to see the cut being made at all times.

## Combustible Gas Detection Equipment

**1215**

Johnson-Williams, Inc., Palo Alto, Calif., has available the J-W Sentinel and J-W Sample Drawing Sentinel combustible gas detection equipment.

The Sentinel is a self-contained, portable, audible alarm unit which, when placed near any hazardous activity, indoors or out, emits a raucous warning if a pre-set concentration of gas is detected. The Sample Drawing Sentinel employs an aspirator bulb and sample hose for exploratory testing from outside a confined danger area.

## Submergible Pump For 4-Inch Wells

**1216**

Reda Pump Company, Bartlesville, Oklahoma, has developed a new 5 horsepower Reda-Submergible pump for a 4-inch well.

The new pump is available in two models: A 5IA18E for depths to 900 feet and 75A7E for depths to 1500 feet. For even deeper 4-inch wells Reda-Submergible pumps are available for depths to 8000 feet or more on special order.

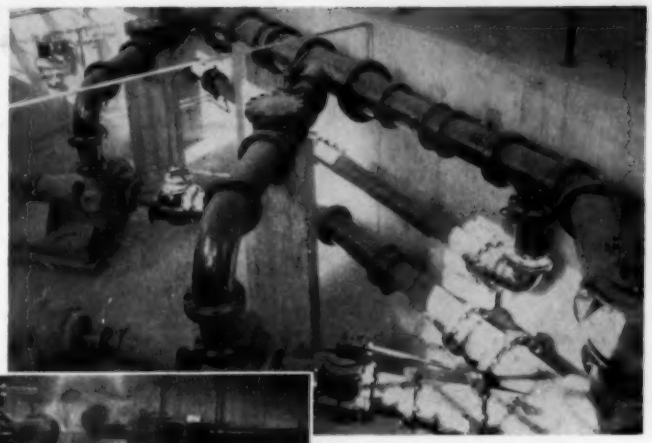
## Computing Device Converts Signals

**1217**

Industrial Div., Minneapolis-Honeywell, Philadelphia, Pa., has developed a new computing device that can be used in pneumatic measurement or control circuits for a variety of purposes.

Called the Sorteberg Force Bridge, it can convert a transmitted signal from a square root flow transmitter into a linear signal; maintain a ratio between two pneumatic signals for flow ratio control; or can also be used to multiply, subtract, divide or square pneumatic outputs, or to provide pressure and temperature compensation for transmitted flow signals.

The design of the bridge assures friction-free operation by the use of the feedback principle in a unique weighbeam and fulcrum system. The principal components are of plug-in construction, housed in a rugged, die-cast case.

**PLANT after PLANT** *is discovering:*

*Only* **DeZurik**

MAKES THE EASY-OPERATING

PLUG VALVES

THAT NEED NO LUBRICATION!

**EXCLUSIVE ECCENTRIC ACTION**

Only DeZurik Valves are designed with Eccentric Action which *guarantees* easy operation and tight closure. The plug contacts the valve seat only when the valve is closed; opening the valve swings the plug away from the seat and it turns easily—without friction, without binding, without lubrication!

- EASY OPERATION WITHOUT LUBRICATION
- ON ALL LINES FROM HEAVY SLUDGE TO GAS
- RESILIENT-FACED PLUGS SEAL TIGHT DESPITE SOLIDS IN THE FLOW
- A QUARTER-TURN FROM WIDE OPEN TO DEAD SHUT
- NO CONTINUAL, COSTLY MAINTENANCE

**The DeZurik Valves pictured above are installed in the Flat Rock Sewage Treatment Plant at Tulsa, Oklahoma (Wood and Craig, Tulsa, Consulting Engineers; W. F. McMurry, Superintendent of Waterworks and Sewerage.) Manufactured in a full range of sizes, DeZurik Valves are ideal for operation on raw sewage, raw sludge, treated sewage, sewage gas, digested sludge, final effluent—wherever tight closure and easy operation are required. Write for complete details on DeZurik Valves. Representatives in all principal cities.**

**DeZURIK CORPORATION Sartell, Minn.**

superior coagulation in cold water months with

N-SOL

(ACTIVATED SILICA)

● Brilliantly clear water, and longer filter runs are results you can count on when you use activated silica made by an N-Sol Process.* As a coagulant aid N-Sol produces tough, compact floc and a much faster settling floc.

Write for instructions and samples for jar tests.

*N-Sol is prepared in your plant with N sodium silicate and a reacting chemical. No charge for license under our N-Sol Process Patents.*

**PHILADELPHIA QUARTZ COMPANY**
1166 Public Ledger Bldg., Phila. 6, Pa.
1831—125TH ANNIVERSARY—1956
*Trademarks Reg. U.S. Pat. Off.*

N-Sol Processes PQ SOLUBLE SILICATES

## W & SW Manufacturers' News

### Embshoff Retires, Infilco Promotes Baker

Infilco Inc., Tucson, Arizona, has announced the retirement of Mr. A. C. Embshoff from active management of the Industrial Division.

Mr. Embshoff specialized in hydraulic design, flotation research and boiler feedwater engineering before he joined the company thirty-five years ago. His wide experience in water treatment problems of the petroleum, pulp and paper and other industries will still be available to the company as a general consultant to the Sales Division, a position he accepted on his retirement on September 1st.

Mr. O. E. Baker succeeds Mr. Embshoff as Manager of the Industrial Division. Orlen Baker has been a member of the industrial division of the company for three years. He early displayed a flair for organization which, in addition to his practical experience in the field and his previous research activities, fits him for his new position and responsibilities.

He, like Mr. Embshoff, received his degree in Chemical Engineering from Purdue University.

### Gurley Appointed V.P. Sales For H. K. Porter Co.

H. K. Porter Company, Inc., New York, N.Y., has announced that Sam Gurley, Jr., has been elected to the post of Vice President-Sales.

Until recently, Mr. Gurley held a similar position with Reichold Chemicals, Inc., and previously had executive positions with Borden Company's Chemical Division and the Barrett Division, Allied Chemical and Dye Corporation. He is a graduate of the University of Missouri, a member of the Chemical Society, Tool Engineers Society and Plastics Society.

### Zatkovitch Appointed Chicago District Sales Manager Of B-I-F

B-I-F Industries, Inc., Providence, R. I., has announced that Theodore R. Zatkovich was recently transferred from Pittsburgh to Chicago to take over the duties

THE PRESSURE IS ON!

Expanded areas of skyscrapers . . . Super highways with their multi-ton trucks and busses . . . Longer water hauls and greater pressure demands from industry and urban areas have put the pressure on! But pressure is part of our business, manufacturing Cast Iron Pipe . . . the pipe that has withstood pressure, stress and strain and rugged treatment for more than a century.

You can be assured with Alabama's Super De Lavaud Cast Iron Pipe. In sizes of 3" to 24" in modern long lengths . . . Bell and Spigot, Roll on Joint, Mechanical Joint and Flanged.

*We invite inquiries to our nearest sales office—*

**122 So. Michigan Avenue**
**Chicago 3, Ill.**

**350 Fifth Avenue**
**New York 1, New York**

ALABAMA PIPE COMPANY

*General Sales Offices*
ANNISTON, ALABAMA

of District Sales Manager. The Chicago sales territory includes offices in Chicago, Milwaukee, Indianapolis and Kansas City, Missouri. Mr. Zatkovich will be in charge of both industrial and municipal sales for the extensive line of meters, feeders, and controls manufactured by B-I-F Industries, Inc.

Mr. Zatkovich is a graduate mechanical engineer from the University of Pittsburgh. His professional affiliations include the Instrument Society of America, the American Institute of Mining & Metallurgical Engineers, Inc., the Eastern States Blast Furnace & Coke Oven Association, the Eastern Ohio Sewage & Industrial Waste Treatment Association, and the American Materials Handling Society.

## Dravo Promotes Hower

Dravo Corporation, Pittsburgh, Pa., has announced the appointment of E. N. Hower as Manager, Engineering and Construction Department Sales.

Mr. Hower formerly was manager of the Machinery Division's Industrial department and has been a member of the Dravo organization since 1947.

The activities of the Engineering and Construction Department include construction of boiler and power plants, oil pumping and gas compressor stations, water pumping stations, sintering and pelletizing plants, mill lubrication systems and similar activities.

## Rockwell Promotes Mankin

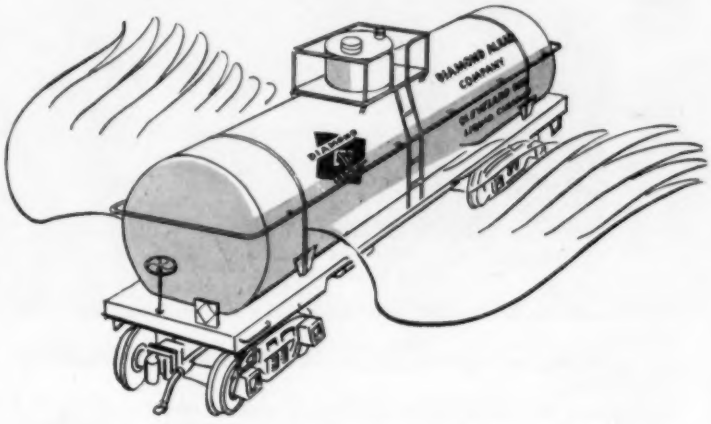
Rockwell Manufacturing Co., Pittsburgh, Pa., has announced that Paul A. Mankin, general manager of the company's Pittsburgh Div., has been appointed chief engineer of the new Central Liquid Meter Research and Development Department.

Mr. Mankin will take charge of the company's water, petroleum, and industrial liquid research and development programs. He will also be in charge of the company's two-year-old meter and valve testing station near Murrysville.

A former vice-president of a major petroleum and chemical and equipment firm, he joined Rockwell in January, 1954, as chief engineer of Pittsburgh Division, becoming general manager a year later.


CHEMICALS YOU LIVE BY

Diamond Chlorine




want chlorine fast?

DIAMOND ALKALI SHIPS FROM 5 CONVENIENTLY LOCATED PLANTS

When you want chlorine or technical co-operation in a hurry, call DIAMOND ALKALI.

We are equipped to give you fast deliveries from five conveniently located plants; technical help from one of the world's greatest stores of chlorine know-how.

Call your nearest DIAMOND sales office or plant for regular or emergency shipments.

FREE! CHLORINE SAFE-HANDLING WALL CHART

DIAMOND ALKALI's years of know-how have been compressed into this chlorine safe-handling wall chart. Hang it where workers can read it. Copies free. Ask your DIAMOND sales office or write DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

DIAMOND ALKALI CHEMICALS

Diamond Chemicals

CHLORINE PLANTS: Edgewood, Md. — Houston, Texas — Muscle Shoals, Ala. Painesville, Ohio — Pine Bluff, Ark.

SALES OFFICES: Cleveland, Cincinnati, Chicago, Houston, Memphis, New York, Philadelphia, Pittsburgh, St. Louis

Spiragester, Aero-filter and Final Spiraflo Clarifier
West Columbia, Texas

The Spiragester is efficient, easy to operate and maintain, and is not offensive to the eye or nose.

For an economical Spiragester plant design, see Fig. 19, Lakeside's Bulletin 135.

Visit booths 37 and 38 at the Oct. 8-11th Annual Meeting of the Federation of Sewage and Industrial Wastes Associations, at the Statler Hotel in Los Angeles, and see the Plastic Model of the Spiragester.

**LAKESIDE ENGINEERING CORPORATION**

222 West Adams St., Chicago 6, Ill.



**Positive drop-tight shut-off**

Easy . . . Efficient . . . Economical with

**LEOPOLD**

Rubber Seated

**BUTTERFLY VALVES**

In this design, the seat is of resilient neoprene rubber or pure gum rubber, vulcanized around a steel ring insert, and held in place by a keeper ring. The steel ring, which is "continuous" to eliminate abnormal wearing, increases the firmness of the seat and assures longer service life.

Whether operated manually or by automatic controls, Leopold Butterfly Valves always provide a positive shut-off that's bubble-tight. Made in sizes 6" to 72".

Meet AWWA Specifications C 504-55T

Leopold

Write today for descriptive literature!

F. B. LEOPOLD CO., INC.
Zelienople, Pa.

COMPLETE WATER PURIFICATION AND FILTER PLANT EQUIPMENT • BUTTERFLY VALVES
FILTER OPERATING TABLES • MIXING EQUIPMENT • DRY CHEMICAL FEEDERS


## Dorr-Oliver Pty. Ltd. Organized in Australia

Dorr-Oliver Incorporated, Stamford, Conn., has announced the formation of Dorr-Oliver Pty. Ltd., a wholly owned subsidiary in Australia. Beginning on January 1, 1957, the new company will design, market and service the complete line of D-O equipment for metallurgical, chemical and industrial usage and for the sanitary field of sewage disposal and water treatment in the Australia-New Zealand area. This new Australian organization becomes the ninth Dorr-Oliver Associated Company.

D. U. Macintosh, associated with D-O activities in Australia since 1933, will be Managing Director of the company. Hobart Duff Pty. Ltd., who have represented D-O interests for the past 27 years, will continue as such for the balance of 1956. W. V. Hobart Duff, Managing Director of Hobart Duff Pty. Ltd., will serve on the Board of Dorr-Oliver Pty. Ltd. and act as adviser-consultant to the new company. Manufacture of D-O equipment will remain in the same hands as before.

Offices for the new company are being established in Melbourne at Collins House, 360 Collins Street, and in Sydney at 39 Pitt Street.

## F. B. Leopold Co. Moves

F. B. Leopold Company, Inc. has moved its operations to new, larger quarters in Zelienople, Pa. The firm, which manufactures water and sewage plant equipment, was formerly located in Pittsburgh.

Leopold's new facilities include a modern one-story brick building of about 10,000 square feet of floor area, which will be used to house the company's offices, as well as its manufacturing equipment.

The announcement pointed out that with these expanded facilities the company will be able to keep pace with the increased demand for its filter bottoms, butterfly valves and other water works equipment.

## Price Brothers Building Concrete Pipe Plant In Hattiesburg, Miss.

Price Brothers Co., Dayton, Ohio, has announced that their new $1,000,000 concrete pressure pipe plant is scheduled for completion during October in Hattiesburg, Miss. Ground was broken in July for the plant which will manufacture pipe in diameters from 16" to 54" and larger.

Price Brothers already has plants in Dayton, Cleveland and Columbus, Ohio, Detroit, Michigan and in Miami, Florida.

The Hattiesburg plant is located on a 20-acre site on Edwards Street adjacent to the B&HS railroad. Land for the project was purchased from the railroad. The new plant will employ about 100 local persons.

## Partain Joins Pittsburgh Coke

Pittsburgh Coke and Chemical Co., Pittsburgh, Pa., has announced that Autrey Z. Partain has been appointed a sales-service representative for the Protective Coatings Division. He will work out of Tulsa, Oklahoma, providing technical service and assistance for the Protective Coatings sales personnel throughout the United States.

A native of Tulsa, Mr. Partain has had a long background in the protective coatings field, especially as it pertains to the oil business. Prior to joining Pittsburgh Coke and Chemical Company, he was associated with Stanolind Oil and Gas Company, working in that firm's research laboratory. Mr. Partain has also worked with protective coatings for the S. E. Bosley Company.

## Diamond Alkali To Expand Houston, Texas Plant

Diamond Alkali Co., Cleveland, Ohio, has announced plans for a multi-million-dollar expansion program at the firm's Deer Park Plant near Houston, Texas.

The expansion is designed to increase the company's present daily production capacity by approximately 200 tons of chlorine, 220 tons of caustic soda, and 2-million cubic feet of hydrogen. These additional facilities are expected to be completed and put into operation during the first half of 1958.

**E. R. P. CATHODIC PROTECTION . . .**

*individually designed for each application*

An effective installation that operates at the lowest cost per year requires experienced engineering evaluation of site and environmental conditions. The Electro Rust-Proofing Engineering Division makes available to you the cumulative experience gained in designing more than 10,000 cathodic protection systems.

Electro Rust-Proofing can furnish any one, or all, of the following services to help you provide proper cathodic protection for each of your jobs:

- Corrosion surveys and recommendations
- Design based on engineering experience
- Cathodic protection equipment and installation
- Service to assure proper operating results

For additional information write today.

ERP CATHODIC PROTECTION SINCE 1935

**ELECTRO RUST-PROOFING CORP.**
A SUBSIDIARY OF WALLACE & TIERNAN INC.
30 MAIN STREET, BELLEVILLE 9, NEW JERSEY
CABLE: ELECTRO, NEWARK, N. J.

E-358

**HOW TO DETECT 3 PARTS CHLORINE IN A MILLION PARTS AIR**

**New W&T Solvay Chlorine Detector***
detects as little as 3 p.p.m. chlorine in a continuous air-stream sample. Automatically sets off alarm at higher concentrations.

***Write for Publication 50.118***

**WALLACE & TIERNAN**
INCORPORATED
25 MAIN ST., BELLEVILLE 9, N. J.

I-55 *Manufactured under patent license from Solvay Process Div., Allied Chemical & Dye Corp.

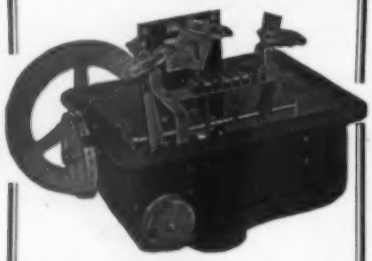
MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

Synonym for...

PURE WATER

ROBERTS FILTER
MANUFACTURING CO.
607 COLUMBIA AVE.
DARBY, PA.

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles.

The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

*Write for full data*

WATER LEVEL CONTROLS DIVISION
HEALY-RUFF COMPANY
783 Hampden Ave., St. Paul 4, Minn.

## Computer-Measurements, Hancock Manufacturing Merge

The Computer-Measurements Corp., North Hollywood, California, is being merged with the Hancock Manufacturing Co., Jackson, Mich., it was announced by John K. Rondou, president of Computer-Measurements. The company will retain its identity and no immediate changes in the present management, manufacturing or sales personnel are planned.

The merger is in line with the industrial diversification and expansion plan of the Hancock company, which manufactures automotive hardware, and it will greatly strengthen the sales and distribution structure of the Computer-Measurements Corp., manufacturer of electronic counting, timing and controlling equipment, and pipe, leak and metal detectors for pipeline contractors and public utility companies.

## Moro M. Borden of Simplex Dies

Simplex Valve and Meter Co., Lancaster, Pa., has announced that Moro M. Borden, 79, Engineering Consultant to the company, died at his home in Collingswood, N. J.

Mr. Borden started his career with the American Pipe and Construction Company in 1902 and joined Simplex at its formation in 1905 as its Chief Engineer. He served in this capacity until 1914 when he became the Simplex General Manager, a position he held until 1938. In that year Mr. Borden became Vice-President in charge of Engineering. In 1946 he became Engineering Consultant to the firm and held this position until his death.

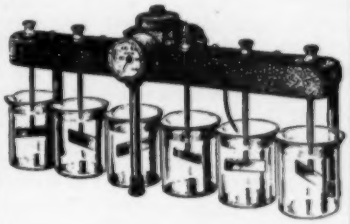
Mr. Borden held a number of patents on flow and control devices; was active in the water and sewage fields for many years and was a life member of AWWA. He was also a member of ASME, Franklin Institute of Philadelphia and the Collingswood, N. J., Lodge F. & A. M.

## W. R. Leopold Jr. Joins Mueller Co.

Mueller Co., Decatur, Ill., has announced the appointment of W. R. Leopold Jr. as Engineering Division Manager. The position is a new one.

The author of a number of technical articles published in several leading national trade magazines, Mr. Leopold comes to Mueller Co. from the Lycomning Division of

P & B Multiple Stirrer



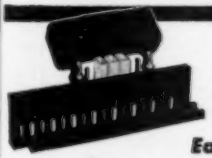
When several samples are mixed simultaneously under identical conditions the optimum concentration of flocculent may be quickly selected and translated to plant quantities . . . The mixer takes 1,000 ml. beakers. Speeds from 15 to 100 r.p.m. are standard.

Write: Cat. No. 77-700

Phipps & Bird, Inc.
P. O. Box 2V Richmond 5, Va.

TAYLOR COMPARATORS

*give accurate pH, CHLORINE TESTS*



COMPLETE, COMPACT KIT—
*Easy To Use*

Exact determinations of pH or chlorine content can be made in a matter of minutes with Taylor Comparators. Easy-to-use Taylor Comparators require no additional equipment or chemicals. Everything necessary to make tests comes with each comparator. Compact carrying case also available. No experience or technical knowledge needed. Simply fill the three tubes with the sample, add reagent to center tube, move color standard slide across until colors match and read value direct from slide. Fluoride Comparators available.

COLOR STANDARDS GUARANTEED

Taylor Liquid color standards carry an unlimited guarantee against fading . . . no danger of mechanical inaccuracy.

SEE YOUR DEALER, or write direct for FREE HANDBOOK, "Modern pH and Chlorine Control". Gives theory and application of pH control. Illustrates and describes all Taylor sets.

W. A. TAYLOR AND CO.
7308 YORK RD • BALTIMORE-4, MD

Avco Manufacturing Corp. in Stratford, Conn., where he was Group Project Engineer in charge of Research and Development.

He holds a Bachelor of Science Degree in Mechanical Engineering from the Illinois Institute of Technology in Chicago and a master of Science Degree in Mechanical Enginering from the Stevens Institute of Technology in Hoboken, N. J.

## Infilco Elects Two Vice Presidents

Infilco, Inc., Tucson, Arizona has announced the election of Mr. E. G. Kominek and Mr. A. A. Kalinske to the offices of Vice-Presidents of the company.

E. G. Kominek

A. A. Kalinske

A graduate in chemistry from the University of Chicago, Mr. Kominek is a registered professional engineer, and a member of the American Institute of Chemical Engineers, American Society for Testing Materials and American Chemical Society. He has made many authoritative contributions to technical publications in the fields of water and waste treatment. During his nineteen years with Infilco, Mr. Kominek has been research chemist, head of the Industrial Waste Division, Assistant Sales Manager and General Sales Manager, a position which he now holds.

Mr. A. A. Kalinske has been Director of Research and Development for Infilco for the past ten years. A graduate in Civil Engineering of the University of Wisconsin where he later taught hydraulics and Sanitary Engineering, Mr. Kalinske is an internationally known expert in the field of fluid mechanics. He is a member of the American Society of Civil Engineers, American Water Works Association, and the American Geographical Union. For many years he has been a frequent and valued contributor to scientific and technical journals.


# how to CUT CORROSION LOSSES

## a report by Koppers Company, Inc.

James Beaumont
Project Leader

How thick should a protective coating on above ground installations be? This is a question that is asked of our Technical Department quite often.

* * *

All other factors being equal, the thicker the protective coating, the longer its service life. Basically, the coating thickness required is dictated by the degree of protection desired and the conditions under which the coating system must perform. Specifically, you need to know the following things about each job: (1) What is the corrosive environment . . . mild? . . . severe? . . . acid? . . . saline? (2) How long must the coating last? . . . is it practical to re-coat every year or are thicker, longer-lasting coatings desirable? (3) The roughness of the surface: since valley-to-peak distance may be as great as 8 to 10 mils, it is vital that peaks be fully covered to the specified thickness. (4) Finally, you should figure the cost of "down time" in terms of lost production.

Another factor in determining coating thickness is the accessibility of the structure. Our pre-coating surveys always include a careful analysis of inaccessible areas where a thicker coating is recommended simply to eliminate for as long as possible the need to re-coat the hard-to-get-at places. This reduces yearly costs by lessening chances of corrosion in places that are passed-by in routine inspections or that are inaccessible.

* * *

The "Steel Structures Painting Manual" (Vol. 1) points out that average industrial conditions warrant a 5-mil coating and severe corrosive conditions need a coating that *must* exceed 10 mils: Generally, our applications research corroborates these recommendations.

It should be remembered that the inherent characteristics of coating materials determine the maximum thickness to which they may be applied in a single coat. For example, some cold-applied coatings of coal-tar base give, in a single coat, a film up to eight times the thickness of ordinary paints. Coal-tar enamels, widely used for pipeline applications, can be applied much more heavily, normal thickness being between 60 and 100 mils. Of course these heavier single-coat thicknesses mean reduced application time and labor costs as well as longer life.

* * *

Every attempt should be made to "police" the application to make sure that the desired thickness is obtained. Checks on wet or dry film thickness can be made with mechanical, electrical or magnetic gauges designed for the purpose.

* * *

If you have specific problems on protective coating thickness . . . or any corrosion-control problems . . . we'd be glad to hear from you. Write to Koppers Company, Inc., Dept. 109M, 1301 Koppers Building, Pittsburgh, Pa. District Offices: Boston, Chicago, Los Angeles, New York, Pittsburgh and Woodward, Ala. In Canada: Koppers Products, Ltd., Toronto, Ontario and Edmonton, Alberta.

KOPPERS

BITUMASTIC
REG. U. S. PAT. OFF.
COATINGS AND ENAMELS

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Outsells . . . Outlasts . . . Outperforms . . . ALL OTHERS!

NEW **AQUA** Water or gas

$29.50 F.O.B. Cin., Ohio Your Name In Gold FREE!

**VALVE BOX LOCATOR**

One on EVERY SERVICE CAR!

- **NATION'S MOST WIDELY USED LOCATOR!**
- **NO WIRES, BATTERIES or SWITCHES** simple, powerful magnetic action, factory adjusted for YOUR geographical location.
- **NO NEEDLE SPINNING**—exclusive electric braking action.
- **TOP VIEW READING**—No stooping.
- **RUGGED, COMPACT, ACCURATE, CONVENIENT!**
- **GUARANTEED**—to function regardless of surface or ground cover.
- **15-DAY FREE TRIAL**—No money! No obligation! You be the judge!

***ORDER NOW—Wire or Call Collect for fastest delivery! PHONE: Kirby 1-4200***

**AQUA SURVEY & INSTRUMENT CO.**
2020 Leslie Ave., Cincinnati 12, Ohio

SterElators by Everson

**Chlorine Gas Control Equipment**
**Visible Flow Indication**
**Vacuum Solution Feed**

for
Water Works
•
Sewage Treatment
•
Industrial Plants
•
Swimming Pools
•
Easy to Install
•
Easy to Operate
•
Low Maintenance Cost
•

**Everson STERELATORS can be furnished for fully automatic, semi-automatic and manual control.**

R. A. Peterson, 11 Broadway, N. Y. 4, N. Y.

**EVERSON MFG. CORP.**
233 W. Huron St., Chicago 10, Ill.

W&SW

# New Literature

## Triple Seal Iron Lubricated Plug Valves

**1218**

The Ohio Injector Company, Wadsworth, Ohio, has available a bulletin on Ohio's Exclusive **Triple Seal Iron Lubricated Plug Valves.**

The bulletin explains the operating features of the valves by means of a cut-away drawing with keyed descriptive text. General dimensions, dimensional drawings and photographs of the various plug valves in the line are also given. A page on lubricants, service recommendations and accessories complete the bulletin.

## Sewer Cleaning Equipment

**1219**

Flexible Inc., Los Angeles, Calif., has published a folder on the **SeweRodeR.**

The folder explains how the SeweRodeR does the dirty work easily and fast at a cost of less than 3c per foot. Both trailer and truck mounted models are shown. The folder opens up in the center to form a large 4-page sheet that shows by means of keyed text the exact operation and special features of the machine. The back page shows the complete line of rod guiding accessories and sewer cleaning tools.

## Vertical Turbine Pumps

**1220**

Layne & Bowler, Inc., Memphis, Tenn., has just released a bulletin that completely describes the water and oil lubricated **Layne Vertical Turbine Pumps.**

The bulletin discusses their application, and pump drive heads designed for water wells serving industry, municipality and agriculture. The water and oil lubricated pumps are also entirely practical for use in pumping from lakes, reservoirs and streams.

## Chemical Feeder

**1221**

Infilco, Inc., Tucson, Arizona, has just published a bulletin on the **Neusol Feeder.**

According to the bulletin the "Neusol" feeder is a compact solution feeder which incorporates either one or two positive displacement diaphragm pumps. Both feed up to a 5% chemical slurry solution and will handle corrosive solutions since no metal parts are exposed to the liquids handled. Illustrations and diagrams point up the text material.

## Sewer Pipe Gaskets

**1222**

Hamilton Kent Manufacturing Co., Kent, Ohio, has just released a 4-page brochure on **Rexon "K" Gaskets,** a new type rubber joint for coupling standard small diameter bell and spigot concrete sewer pipe.

The brochure contains engineering data and diagrams showing how the gaskets provide effective, yet low cost flexible joints by eliminating the need of more expensive pipe manufactured specially for use with conventional rubber gaskets.

Rexon "K" gaskets are for pipe from 4 to 24 inches in diameter. Method of application is fully explained in the brochure, and photographs from actual pipe jobs show how the gasketed pipe is installed into the line.

## Meters and Controls

**1223**

Bailey Meter Company, Cleveland, Ohio, has just released an 8-page bulletin describing over 100 measuring, transmitting, receiving, recording, and **Indicating Instruments and Control Components** for power and process applications.

Included is detailed literature references for each product as well as 24 instrument and control applications. Addresses and phone numbers of a 11 district offices are also listed.

## Blower Bulletin

**1224**

Read Standard Corp., New York, N. Y., has just published a revised 4-page, 2-color bulletin containing selection charts and other useful

engineering information pertaining to the **"Standardaire" Blower.**

Selection charts give the blower model, brake horsepower and rpm needed to provide specified air-moving capacities in cfm at required pressures in psig or vacuums in inches of mercury. The blower will handle air, gas or vapor, as modified for each particular service.

## Sentry Full Flow Valves

**1225**

Coppus Engineering Corporation, Worcester, Mass., has available a new 4-page bulletin dealing with eight types of **Coppus Sentry Full Flow Valves.**

Detailed text illustrated with engineering drawings, explains the design, function, materials, and specifications of these 8 valves.

## Explosion-Proof Motors

**1226**

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has just released a bulletin giving the latest design features of **A-C Explosion-Proof Motors** in NEMA rerated ratings of ½ to 30 hp, and in non-rerated ratings of ½ to 100 hp.

According to the bulletin, new features of the rerated motors include a diagonally split cast iron conduit box for increased accessibility and ease of wiring, and a rotating shaft seal on the shaft extension end of a material impervious to corrosive agents.

In addition to cutaway views of the motor, the bulletin includes tables of ratings and dimensions as well as a horsepower frame chart.

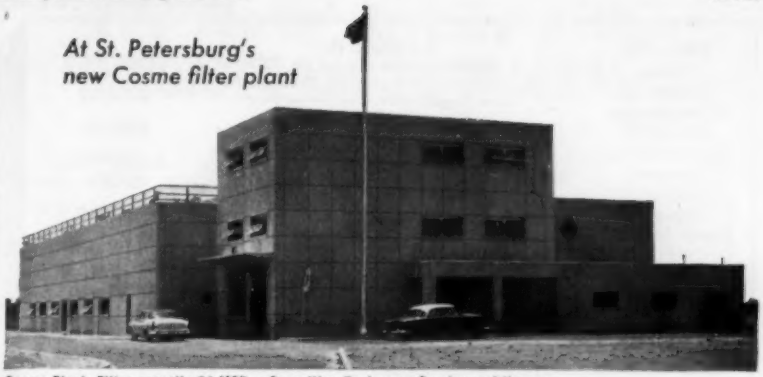
## Float-Actuated Flow Meter

**1227**

Minneapolis-Honeywell Regulator Co., Philadelphia, Pa., has released a specification sheet that describes the **Brown Evenly Graduated Float-actuated Flow Meters,** designed for use with Parshall flumes and Cipoletti, rectangular or V-notch weirs.

The specification sheet describes the flow meters, for measuring differentials from 0-6 to 0-48 inches of water, as particularly suitable for applications such as measurement of sewage, industrial wastes, chemical slurries of irrigation water, where, due to abrasive or corrosive liquids, or low head, other primary elements are not suitable.

*At St. Petersburg's new Cosme filter plant*



Cosme Plant: Filter capacity 24 MGD • Consulting Engineers: Greeley and Hansen
Mechanical Contractor: Bass Construction Co.

# Simplex provides Centralized automatic filter control!

The St. Petersburg, Florida, water system has just been expanded. In the Cosme plant, the latest addition—a new, master pneumatic control system provides the dependable accuracy that assures *maximum filter efficiency.*

Backbone of the system are tried and proven Simplex "S" Controllers for each filter to keep rate-of-flow constant despite changes in head. From these direct-acting controllers, new Simplex Laminair Converters transmit pneumatic signals instantly. So at the new, sensitive bellows-type Receiving Instruments, there's no hunting, no lag, no inaccuracies!

Results: Rate of flow, loss of head and water levels are indicated and recorded, with total plant flow summated, *at one central table* that operates all filters at optimum rates.

Filter gallery: Diaphragm pots for Master Pneumatic System are just above counterbalanced arms of the Simplex Controllers.

At this one table, Simplex pneumatic receivers give centralized measurement of summated plant output and centralized control of flow.

**FREE TECHNICAL INFORMATION!**
Write Simplex Valve & Meter Company, Dept. WS12
7 E. Orange St., Lancaster, Pa.

**Accurate instruments and controls for over 50 years**

**SIMPLEX®**
VALVE AND METER COMPANY

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

CHEMCO Filters
CHEMCO Chlorinators
CHEMCO Recirculation Systems
CHEMCO Pumps & Pump Strainers
CHEMCO Inlet & Outlet Fittings
CHEMCO Testers & Chemicals

CHEMCO
P. O. Box 3098, Los Angeles 54, Calif.
Rm. 1217—205 W. Wacker Dr., Chicago 6, Ill.
"Agents Throughout the U. S. and Civilized World"

SEND FOR 4-PAGE COLOR ANNIVERSARY FOLDER EXPLAINING THIS CARTOON

"EVERYTHING FOR THE SWIMMING POOL"

*Write Today For 108 Page Catalog*
W. S. DARLEY & CO. Chicago 12

## Diaphragm Valves

**1228**

Hills-McCanna Company, Chicago, Illinois, has just released a 2-color, 12-page catalog featuring **Diaphragm Valves.**

This catalog describes Hills-McCanna diaphragm valves in terms of their advantages, applications and specifications. The three basic types of valve operations are shown and dimensional specifications are given. Information is also included on plastic bodies and diaphragms.

SODIUM SILICOFLUORIDE
*(Fluosilicate)*
*Inquiries Invited!*
TENNESSEE TC CORPORATION
1028 CONNECTICUT AVE., N. W.
WASHINGTON 6, D. C.

## Super Cleaning Of Atmospheric Air

**1229**

Wheelabrator Corp., Mishawaka, Indiana, has just published a bulletin on **Super Clean Air.**

According to the bulletin, the super cleaning of ordinary atmospheric air is accomplished by means of specially adapted industrial cloth-filter-type dust collector.

Dealing with the Wheelabrator Ultra-filtration process, the bulletin has two case histories of installations where this process is used for cleaning dust out of ordinary city or country air.

The bulletin states that ultra-filtration is applicable to the cleaning of cooling air for electrical motor and generator rooms, laboratories, precision manufacturing areas, and for the cleaning of air for diffuser plates and tubes in activated sludge sewage plants.

## Pneumatic Controllers

**1230**

The Bristol Co., Waterbury, Conn., has just published a 56-page bulletin describing the new series 500W **Pneumatic Controller.**

This new two-color bulletin is illustrated by more than 75 photos and drawings, describing the new high sensitivity, wide control-band controllers for temperature, pressure, flow, vacuum, etc. Features of the new controllers mentioned include: control band width ½% to 400%, high sensitivity without loss of stability, precision linkage allowing reassembly and recalibration with only one adjustment, and reset action stops.

Sections describing control principles, and illustrating the various control modes available are included.

## Water Treatment Equipment

**1231**

General Filter Company, Ames, Iowa, has available 3 new 2-page bulletins in water treatment equipment. They cover **Degasifiers, Pressure Aeration, and Vertical Flocculators.**

Each of the bulletins are illustrated with a photograph and drawing, and a short description of the unit presents the features, sizes and specifications. Tables on design and performance data on the units are also included.

HYDRO-TITE
DEPENDABLE JOINTING COMPOUND
*Seals Bell and Spigot Water Mains*
Economical—Effective
Over 35 Years Of Dependable Performance

HYDRAULIC DEVELOPMENT CORP.
*MAIN SALES OFFICE* 50 CHURCH ST., N. Y. C.
General offices and works W. Medford Sta., Boston, Mass.

## Vertical Filing System Holds Plans, Blueprints

**1232**

Plan Hold Division, Air Comfort Co., South Gate, Calif., has available an 8-page catalog, **"The Plan Hold Story"**, that shows four different methods of vertically filing blue prints, maps, etc.

Included in the catalog is the Type "S" standard Plan Hold which can be used in various "home-made" racks in place of sticks, slats, etc.

According to the catalog, holes

and other multilations are completely eliminated with Plan Hold friction type binders made of light weight aluminum and they will hold from 1 to 150 sheets.

## Hot Lime-Zeolite Softeners

**1233**

Cochrane Corporation, Philadelphia, Pa., has just released a bulletin on the versatility and economy of **Cochrane Hot Lime-Zeolite Water Conditioning Systems.**

The bulletin deals with the method of operation, expected results, chemical savings, simplicity of operation, and brings out the fact that with the addition of the zeolite stage, the application of hot process to water conditioning is practically limitless.

## Time Controls

**1234**

Paragon Electric Company, Two Rivers, Wisconsin, has just published a 20-page information booklet that is a complete reference to **Multi-Purpose and Industrial Time Controls.**

The booklet can be used as a check list of leading Paragon time switches and timers. It also provides the correct answers for countless electrically operated automatic on-off operations.

A fold-out reference chart clearly defines what each control is, what it does, where it may be used and how to select and purchase it.

## Distribution Systems For Automatic Lubricators

**1235**

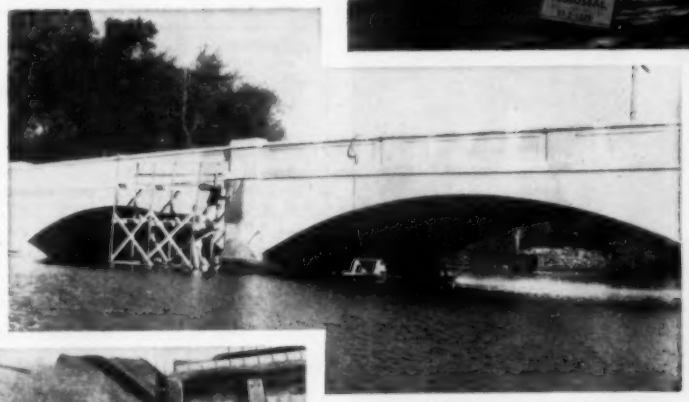
Bijur Lubricating Corp., Rochelle Park, N. J., has issued a 2-color, 12-page brochure describing and illustrating **Bijur Automatic Lubrication Distribution Systems.**

The bulletin describes the detailed planning of all systems and their many applications to a wide range of machinery. Following a system from oil reservoir to lubrication point, the brochure tells how and where to obtain the best results from any system.

Reservoirs, tubing, fittings, junctions and Meter-units are discussed in separate sections of the brochure. 25-drawings and photographs illustrate components of the systems, schematic layouts of systems and actual installations.


# It's New Again with THORITE and THOROSEAL

Freeze-thaw cycle following water and moisture penetration, also swelling of reinforcing rods from moisture contact, cause masonry destruction.



BRIDGE OVER CONCORD RIVER
ROUTE 3, BELLERICA, MASS.

Workmen on scaffold patch spalled and cracked concrete with THORITE and seal surface with THOROSEAL.

Area at left chipped to sound masonry. It will then be patched with THORITE *Nonshrink, Nonslump 20-Minute Set Patching Mortar*, without necessity of costly forming, finished by application of Thoroseal.

***Request Circular No. 16 and 20.***

*Write for our 16 page "How to Do It"*

STANDARD DRY WALL PRODUCTS, INC.
NEW EAGLE, PENNSYLVANIA • CENTERVILLE, INDIANA

# Delta Air Lines Gives $225,000 Bonus in U. S. Savings Bonds

C. E. WOOLMAN
*President and General Manager*
DELTA AIR LINES

## *Delta Air Lines, Inc.*

GENERAL OFFICES · ATLANTA AIRPORT · ATLANTA, GEORGIA

TO: All Members of Delta Family

FROM: President and General Manager

This has been a difficult but successful year. Each of us has had a hand in our accomplishments.

Again we want to share our good fortune with all our people and it is a pleasure to announce that all personnel with more than six months of service as of May 24, 1956, will receive a $50.00 U.S. Savings Bond. All personnel with six months of service or less as of that date will receive a $25.00 U.S. Savings Bond. The total value of these bonds will be about $225,000.00.

The bond is both a share in our achievements and an added expression of appreciation for your contribution to them.

C.E. Woolman

Delta

If you are wondering whether *your* employees would prefer Savings Bonds to Cash . . . take a quick glance at these figures:

. . . 8,000,000 Americans enrolled in the Payroll Savings Plans of *40,000* companies invest $168 Million *per month* in U. S. Savings Bonds.

. . . 40,000,000 Americans hold $41 Billion (cash value) in Series E and Series H Savings Bonds . . . a huge reservoir of future purchasing power.

. . . 67% of *all* Series E Bonds that matured up to June, 1956—more than $21 Billion—are being held by their owners under the automatic extension program.

Join Delta Airlines—and many other fine companies—give your Bonus in Bonds—the gift that grows. Savings Bond Division, U.S. Treasury Department, Washington 25, D. C.

*The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and*

**WATER & SEWAGE WORKS**

# Consulting Engineers

SPECIALIZING IN THE FIELD OF

WATER & SEWAGE WORKS

## ALBRIGHT & FRIEL INC.

*Consulting Engineers*

Water, Sewage, Industrial Wastes and Incineration Problems—City Planning, Highways, Bridges and Airports—Dams, Flood Control, Industrial Buildings—Investigations, Reports, Appraisals and Rates—Laboratory for Chemical & Bacteriological Analyses—Complete Service on Design and Supervision of Construction.

Three Penn Center Plaza
Philadelphia 2, Pa.

## BOYLE ENGINEERING

*Consulting Engineers*

Water—Sewers—Streets
Structures—Surveys
Reports—Special Districts

331 Spurgeon Bldg. Santa Ana, Calif.
3913 Ohio, Rm. 200 San Diego 4, Calif.

## The Chester Engineers

Water Supply and Purification—Sewage and Industrial Waste Treatment—Power Plants—Incineration—Gas Systems—Valuations—Rates—Management—Laboratory—City Planning

601 Seusmon Street
Pittsburgh 12, Penna.

## Alvord, Burdick & Howson

*Engineers*

Water Works, Water Purification, Flood Relief, Sewerage, Sewage Disposal, Drainage, Appraisals, Power Generation

20 N. Wacker Drive, Chicago 6, Ill.

## Bowe, Albertson & Associates

*Engineers*

Water and Sewage Works—Industrial Wastes—Refuse Disposal—Municipal Projects—Industrial Buildings—Reports—Plans—Specifications—Supervision of Construction and Operation—Valuations—Laboratory Service

75 West Street, New York 6, New York

## Chas. W. Cole & Son

*Engineers — Architects*

Sewerage, Water Supply, Bridges, Highways, Toll Roads, Industrial, Municipal and Commercial Buildings

220 W. LaSalle Ave., South Bend, Indiana
Central 4-0127

## JOHN J. BAFFA

*Consulting Engineer*

Water Supply and Treatment
Sewerage and Sewage Treatment

75 West Street, New York 6, N. Y.

## Buck, Seifert and Jost

*Consulting Engineers*

Water Supply, Sewage Disposal, Hydraulic Developments, Reports, Investigations, Valuations, Rates, Design Construction Operation Management, Chemical and Biological Laboratories

112 East 19th St., New York

## CONSOER, TOWNSEND & ASSOCIATES

Water Supply, Sewerage, Flood Control & Drainage, Bridges, Express Highways, Paving, Power Plants, Appraisals, Reports Traffic Studies, Airports, Gas & Electric Transmission Lines.

360 East Grand Ave., Chicago 11, Ill.

## MICHAEL BAKER, JR., INC.

The Baker Engineers

Civil Engineers, Planners, and Surveyors

Airports, Highways, Sewage Disposal Systems, Water Works Design and Operation—City Planning—Municipal Engineering—All types of Surveys

Home Office: Rochester, Pa.
Branch Offices:
Jackson, Miss. Harrisburg, Pa.

## BURGESS & NIPLE

*Civil and Sanitary Engineers*

Water Supply and Purification
Sewerage and Sewage Treatment
Appraisals, Reports, Valuations

2015 West Fifth Avenue
Columbus 12, Ohio

## COTTON, PIERCE, STREANDER, INC.

*Associated Engineering Consultants*
132 Nassau St., New York, N. Y.
Colon 106—Havana, Cuba
55 Caroline Rd., Gowanda, N. Y.
2718 Garfield St., Hollywood, Fla.

Water Supply Treatment, Distribution, Sewerage, Sewage Treatment, Refuse Disposal, Trade Wastes, Power Plants, Reports, Plans, Supervision.

## W. H. & L. D. BETZ

CONSULTING ENGINEERS

INDUSTRIAL WASTE
INDUSTRIAL WATER
ANALYSIS DESIGN
INVESTIGATIONS OPERATION

Gillingham & Worth Sts.
Philadelphia 24, Pa.

## BURNS & McDONNELL

*Consulting and Designing Engineers*

Kansas City Mo.
P.O. Box 7088

Cleveland Ohio
1404 E. 9th St.

## DE LEUW, CATHER & COMPANY

Water Supply — Sewerage
Railroads — Highways
Grade Separations—Bridges—Subways
Local Transportation

Investigations—Reports—Appraisals
Plans and Supervision of Construction

150 North Wacker Drive, Chicago
79 McAllister Street, San Francisco 2, Calif.

## BLACK & VEATCH

*Consulting Engineers*

Water—Sewage—Electricity
Industry

Reports, Design, Supervision of Construction, Investigations, Valuations and Rates

4706 Broadway, Kansas City 2, Missouri

## Camp, Dresser & McKee

*Consulting Engineers*

6 Beacon Street, Boston 8, Mass.

Water Works and Water Treatment; Sewerage and Sewage Treatment; Municipal and Industrial Wastes; Investigations and Reports; Design and Supervision; Research and Development; Flood Control.

## FAY, SPOFFORD & THORNDIKE, Inc.

*Engineers*

Water Supply and Distribution—Drainage
Sewerage and Sewage Treatment
Airports—Bridges—Turnpikes
Port and Terminal Works—Industrial Bldgs.

Investigations, Reports, Designs, Valuations
Supervision of Construction

11 Beacon Street, Boston 8, Mass.

## BOGERT AND CHILDS

CONSULTING ENGINEERS

Clinton L. Bogert — Fred S. Childs
Ivan L. Bogert — Donald M. Ditmars
Robert A. Lincoln — Charles A. Manganaro
William Martin

*Water & Sewage Works • Refuse Disposal*
*Drainage • Flood Control • Highways and Bridges • Airfields*

145 East 32nd Street, New York 16, N. Y.

## CAPITOL ENGINEERING CORPORATION

*Engineers—Constructors—Management*

SEWAGE SYSTEMS — WATER WORKS
Designs and Surveys — Roads and Streets
Planning — Airports
Bridges — Dams

Executive Offices
DILLSBURG, PENNSYLVANIA

## Finkbeiner, Pettis & Strout

Carleton S. Finkbeiner, C. E. Pettis, Harold K. Strout

*Consulting Engineers*

Reports Designs Supervision

Water Supply, Water Treatment, Sewerage, Sewage Treatment, Wastes Treatment, Valuations & Appraisals

518 Jefferson Avenue, Toledo 4, Ohio

*Additional Engineers Cards on Next Page*

**Freese & Nichols**
FORT WORTH, TEXAS
**Freese, Nichols & Turner**
HOUSTON, TEXAS
Industrial and Municipal Engineering—Water Supply and Purification—Sewerage and Industrial Waste Treatment—Highways and Structures—Dams—Drainage Works—Airports—Investigations—Valuation—Design and Supervision

**HAZEN AND SAWYER**
*Engineers*
Water and Sewage Works
Industrial Waste Disposal
Drainage and Flood Control
Reports, Design, Supervision of Construction and Operation
Appraisals and Rates
122 East 42nd St., New York 17, N. Y.
3333 Book Tower, Detroit 26, Mich.

**LANNING**
**Sanitary Engineering Co., Inc.**
*Consulting Engineers*
Professional Building
1100 South Broad Street
Trenton, New Jersey

**GANNETT FLEMING CORDDRY AND CARPENTER, INC.**
*Engineers*
HARRISBURG, PA.
Pittsburgh, Pa. Daytona Beach, Fla.
Philadelphia, Pa.
Water Works, Sewage, Industrial Wastes and Garbage Disposal—Roads, Airports, and Garbage Disposal—Roads, Airports, Bridges, Flood Control, Traffic & Parking, Appraisals, Investigations & Reports.

**HENNINGSON, DURHAM & RICHARDSON**
Consulting Engineers since 1917 for more than 700 cities and towns.
Water Works, Light and Power, Sewers, Sewage Treatment, Reports, Flood Control, Appraisals, Drainage, Paving.
2962 Harney St., Omaha 2, Nebraska

**LOCKWOOD GREENE ENGINEERS, INC.**
*Architects - Engineers*
Montgomery Building
SPARTANBURG, S. C.
Water Supply—Power Plants
Sewage Disposal—Valuations & Appraisals
Industrial Waste—Industrial Plant Design

**GILBERT ASSOCIATES, INC.**
*Engineers and Consultants*
Water Supply and Purification
Sewage and Industrial Waste Treatment
Chemical Laboratory Service
Investigations and Reports
New York, Reading, Pa., Washington, Houston, Philadelphia

**MR. CONSULTING ENGINEER**
Are you interested in both
WATER & SEWAGE
If so there is no better place for your professional card than in this dual interest magazine.
Water & Sewage Works

**WM. S. LOZIER CO.**
Sewerage, Sewage Disposal, Water Supply, Water Purification
Refuse Disposal
*Consulting Engineers*
10 Gibbs Street, Rochester 4, N. Y.

**GLACE AND GLACE**
*Consulting Sanitary Engineers*
WATER SUPPLY AND PURIFICATION
SEWERAGE AND SEWAGE TREATMENT
Design, Construction and Supervision of Operation
1001 North Front St., Harrisburg, Pa.

**The Jennings-Lawrence Co.**
*Civil & Municipal Engineers*
Consultants
Water Supply, Treatment & Distribution
Sewers & Sewage Treatment
Reports—Design—Construction
1392 King Ave., Columbus 12, Ohio

**Metcalf & Eddy**
*Engineers*
Water, Sewage, Drainage, Refuse and Industrial Waste Problems
Airports, Valuations
Laboratory
Statler Building, Boston 16

**GREELEY AND HANSEN**
*Engineers*
Samuel A. Greeley, Paul Hansen (1920-1944)
Paul E. Langdon, Kenneth V. Hill
Thomas M. Niles, Samuel M. Clarke
Water Supply, Water Purification
Sewerage, Sewage Treatment
Flood Control, Drainage, Refuse Disposal
220 S. State Street, Chicago 4

**Jones, Henry & Williams**
*Consulting Sanitary Engineers*
Water Works
Sewerage & Treatment
Waste Disposal
821 Security Bldg., Toledo 4, Ohio

**Nussbaumer, Clarke & Velzy, Inc.**
Newell L. Nussbaumer—Irving Clarke—Charles R. Velzy
Water Supply and Treatment
Sewerage & Sewage Disposal
Garbage Incineration
Municipal Planning
500 Fifth Avenue, New York 36, N. Y.
327 Franklin St., Buffalo, N. Y.

**HASKINS, RIDDLE & SHARP**
*Consulting Engineers*
Water—Sewage & Industrial Wastes—Hydraulics
Reports, Design, Supervision of Construction
Appraisals, Valuations, Rate Studies
1009 Baltimore Ave., Kansas City 5, Mo.

**R. L. KENAN & ASSOCIATES**
CONSULTING ENGINEERS
Water Works, Flood Control, Sewerage, Sewage Disposal, Airports, Harbor and Waterfront Improvements.
MONTGOMERY, ALA. PENSACOLA, FLA.

**PARSONS, BRINCKERHOFF HALL & MACDONALD**
G. Gale Dixon, Associate
*Civil and Sanitary Engineers*
Water, Sewage, Drainage and Industrial Waste Problems.
Structures—Power—Transportation
51 Broadway, New York 6, N. Y.

**HAVENS AND EMERSON**
W. L. HAVENS, A. A. BURGER
J. W. AVERY, H. H. MOSELEY
F. S. PALOCSAY, E. S. ORDWAY
F. C. TOLLES, CONSULTANT
CONSULTING ENGINEERS
WATER, SEWERAGE, GARBAGE, INDUSTRIAL WASTES VALUATIONS—LABORATORIES
LEADER BLDG., CLEVELAND 14, O.
WOOLWORTH BLDG., NEW YORK 7, N. Y.

Engineering Office of
**CLYDE C. KENNEDY**
SANITARY ENGINEERING
SAN FRANCISCO

**MALCOLM PIRNIE ENGINEERS**
Malcolm Pirnie, Ernest W. Whitlock
Robert D. Mitchell, Carl A. Arenander
Malcolm Pirnie, Jr.
MUNICIPAL AND INDUSTRIAL
Water Supply—Water Treatment
Sewage and Waste Treatment
Drainage—Sewerage—Refuse Disposal
25 West 43rd St., New York 36, N. Y.

**Hayden, Harding & Buchanan, Inc.**
*Consulting Engineers*
John L. Hayden
John H. Harding, Oscar J. Compto
Waterworks, Sewerage, Civil, Mechanical, Electrical, Structural
1346 Soldiers Field Road, Boston 35, Mass.

**Morris Knowles, Inc.**
*Engineers*
Water Supply and Purification, Sewerage and Sewage Disposal Valuations, Laboratory, City Planning
1312 Park Building, Pittsburgh, Pa.

**THE PITOMETER ASSOCIATES, INC.**
*Engineers*
Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurements & Special Hydraulic Investigations
New York, 50 Church Street


*Additional Engineers Cards on Next Page*

**LEE T. PURCELL**
*Consulting Engineers*
Water Supply & Purification; Sewerage & Sewage Disposal; Industrial Wastes; Investigations & Reports; Design; Supervision of Construction & Operation
Analytical Laboratories
36 De Grasse Street — Paterson 1, N. J.

**Benjamin L. Smith & Associates**
*Engineers*
Investigations—Reports
Designs—Supervision—Valuations
Municipal Engineering and Public Utilities
11 North Pearl Street
Albany 7, New York

**Wertz Engineering Co., Inc.**
Consultants, Designers & Constructors
Water Supply & Purification
Sewage & Industrial Waste Treatment
Stream Pollution Studies
Chemical & Bact. Laboratory Service.
441 North 2nd St. — Reading, Pa.

**Thomas M. Riddick**
*Consulting Engineer and Chemist*
Municipal and Industrial Water Purification, Sewage Treatment, Plant Supervision, Stream Pollution Investigations, Chemical and Bacteriological Analyses.
369 East 149th Street
New York 55, N. Y.

**STANLEY ENGINEERING COMPANY**
*Consulting Engineers*
208 S. LaSalle St. — Hershey Building
Chicago 4, Ill. — Muscatine, Iowa

**Weston & Sampson**
Water Supply, Water Purification, Sewerage, Sewage and Industrial Waste Treatment, Corrosion Control, Laboratory Service Supervision, Valuations
14 Beacon St. — Boston, Mass.

**ROBERT AND COMPANY ASSOCIATES**
Engineering Division
ATLANTA

**Alden E. Stilson & Associates**
Limited
*Consulting Engineers*
Water Supply—Sewage—Waste Disposal
Bridges—Highways—Industrial Buildings
Studies—Surveys—Reports
245 North High St. — Columbus, Ohio

**WHITMAN, REQUARDT & ASSOCIATES**
*Engineers—Consultants*
Civil—Sanitary—Structural—Mechanical—Electrical
Reports, Plans, Supervision, Appraisals
1304 St. Paul Street
Baltimore 2, Maryland

**J. E. SIRRINE Company**
*Engineers*
Water Supply & Purification
Sewage & Industrial Waste Disposal
Stream Pollution Reports
Utilities, Analyses
Greenville — South Carolina

**UHLMANN & ASSOCIATES**
PAUL A. UHLMANN — H. E. BONHAM
CARL E. KUCK — NYE GRANT
*Consulting Engineers*
Water Supply and Purification
Sewage and Industrial Waste Treatment
4954-58 N. High St. — Columbus 14, O.

**Whitman & Howard**
*Engineers (Est. 1869)*
Water Supply, Water Purification, Sewerage, Sewage Disposal, Water Front Improvements and all Municipal and Industrial Development Problems, Investigations, Reports, Designs, Supervision, Valuations.
89 Broad St., Boston, Mass.

Hotel
**FOURTEEN**
at 14 east 60th st.

New York's distinguished address—between Fifth & Madison—overlooking world-famous Central Park. Just a few steps from exclusive shops and midtown business district. Half block from buses and subway.

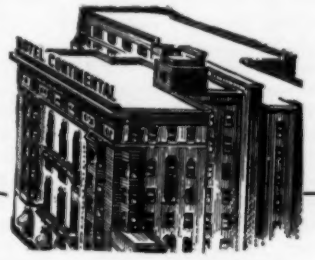
Rooms and suites—many with butler's pantry. Air-conditioning—TV available. Garage.

Home of the COPACABANA
Internationally known
GOLD LEAF ROOM
& COCKTAIL ROOM
PHONE ELdido 5-6000
14 East 60th Street
**NEW YORK**
A. B. WRIGHT, Mgr.
Also under same management
Hotel SUTTON PLAZA
116 East 58th Street
PLaza 8-4520

**POSITION WANTED**

AVAILABLE Water and Sewage Utility Manager. Twenty years experience in all phases of operation and management including water treatment. Just returning from constructing water systems abroad. Registered with Professional Engineer. Will consider public or private connection. Box 1150, WATER & SEWAGE WORKS, 185 North Wabash Ave., Chicago 1, Illinois.

*Overlooking the Fenway*
**Boston,** *Mass.*
Attractive, comfortable, homelike rooms, suites and kitchenettes—near Kenmore Square and Boston University. Modern, fireproof building. *from* $6 double
FAMILY PLAN
Special rates for permanent guests.
Hotel **CANTERBURY**
14 Charlesgate West, Boston, Mass.



FACING CAPITOL PLAZA
Hotel
**CONTINENTAL**

• Large fireproof hotel surrounded by parks—across from the Capitol, near all sightseeing and Union Station. Garage on premises. Coffee Shop—Cocktail Lounge—convention facilities.

*From* $5 Single
With Bath

*Spacious Guest Rooms—*
*Air-Conditioned, if desired.*

**WASHINGTON, D.C.**

# INDEX TO ADVERTISERS


A

*A.C.F. Valves ..... Inside Front Cover
*Alabama Pipe Co. ..... 100A
Albright & Friel, Inc. ..... 111A
Alvord, Burdick & Howson ..... 111A
American Hard Rubber Co. ..... 86A
Aqua Survey Instr. Co. ..... 106A
Aurora Pump Div. ..... 86A

B

Badger Meter Mfg. Co. ..... 11A
Baffa, John J. ..... 111A
Baker, Jr., Michael ..... 111A
Betz, W. H. & L. D. ..... 111A
*B-I-F Industries, Inc. ..... 12A-88A
Black & Veatch ..... 111A
Bogert and Childs ..... 111A
Bowe, Albertson & Associates ..... 111A
Boyle Engineering ..... 111A
Buck, Seifert and Jost ..... 111A
*Builders-Providence, Inc. ..... 12A-88A
Burgess & Niple ..... 111A
Burns & McDonnell ..... 111A

C

Calgon, Inc. ..... 91A
Camp, Dresser & McKee ..... 111A
Capitol Engineering Corporation ..... 111A
Cast Iron Pipe Research Ass'n. ..... 18A-19A
Chapman Valve Mfg. Co. ..... 26A
*Chemco ..... 108A
Chester Engineers, The ..... 111A
*Chicago Bridge & Iron Co. ..... 31A
*Chicago Pump Company ..... 81A
Cleveland Trencher Co. ..... 85A
Cole & Son, Chas. W. ..... 111A
*Columbia Southern Chem. Corp. ..... 89A
*Combustion Eng. Inc. ..... 95A
Consoer, Townsend & Associates ..... 111A
Cotton, Pierce, Streander, Inc. ..... 111A
Crane Co. ..... 28A

D

Darley Co., W. S. ..... 108A
DeLeuw, Cather & Company ..... 111A
DeZurik Corp. ..... 99A
Diamond Alkali Co. ..... 101A
*Dorr-Oliver ..... Inside Back Cover

E

Eddy Valve Co. ..... 21A
Electro-Rust Proof Corp. ..... 103A
Everson Mfg. Corp. ..... 106A

F

Fay, Spofford & Thorndike ..... 111A
Finkbeiner, Pettis & Strout ..... 111A
*Fischer & Porter Co. ..... 4A
Flexible, Inc. ..... 90A
Foxboro Co. ..... 20A
Freeze, Nichols & Turner ..... 112A
Friedewald, F. R. ..... 112A

G

Gannett Fleming Corddry and Carpenter, Inc. ..... 112A
Gilbert Associates, Inc. ..... 112A
Glace & Glace ..... 112A
Greeley & Hansen ..... 112A
Grinnell Co. Inc. ..... 82A

H

Hamilton Kent Mfg. Co. ..... 25A
Haskins, Riddle & Sharp ..... 112A
Havens & Emerson ..... 112A
Hayden, Hardin & Buchanan ..... 112A
Hazen & Sawyer ..... 112A
Healy-Ruff Company ..... 104A
Henningson, Durham & Richardson ..... 112A
Hersey Manufacturing Company ..... 13A
Homestead Valve Mfg. Co. ..... 33A
Hooker Electrochemical Co. ..... 27A
Hotel Canterbury ..... 113A
Hotel Continental ..... 113A
Hotel Fourteen ..... 113A
Hydraulic Development Corp. ..... 108A

I

Infilco Inc. ..... Back Cover

J

Jennings-Lawrence Co., The ..... 112A
Jones, Henry & Williams ..... 112A

K

Kenan & Associates, R. L. ..... 112A
Kennedy, Clyde C. ..... 112A
Knowles, Inc., Morris ..... 112A
*Komline-Sanderson Engr. Corp. ..... 9A
Koppers Co. ..... 105A

L

Lakeside Engr. Corp. ..... 102A
Lanning San. Engr. Co. ..... 112A
Layne & Bowler, Inc. ..... 17A
*Leopold & Co., Inc., F. B. ..... 102A
Le Roi Co. ..... 29A
Lockwood Greene Engrs., Inc. ..... 112A
Lozier Co., Wm. C. ..... 112A
*Ludlow Valve Mfg. Co. ..... 22A

M

*M & H Valve & Fittings Co. ..... 92A
Metcalf & Eddy ..... 112A
Minneapolis-Honeywell Reg. Co. ..... 14A
Mortell Co., J. W. ..... 84A
*Mueller Company ..... 15A
Multiplex Mfg. Co. ..... 98A

N

*National Clay Pipe Mfrs., Inc. ..... 3A
*Neptune Meter Company ..... 34A
Nussbaumer, Clarke & Velzy, Inc. ..... 112A

P

*Pacific Flush Tank Company ..... 16A
Parsons, Brickerhoff, Hall & MacDonald ..... 112A
Phelps Dodge Refin. Corp. ..... 94A
*Philadelphia Quartz Co. ..... 100A
*Phipps & Bird, Inc. ..... 104A
Pirnie Engineers, Malcolm ..... 112A
Pitometer Associates, Inc., The ..... 112A
*Pittsburgh-Des Moines Steel Co. ..... 10A
Portland Cement Ass'n. ..... 24A
Pressure Concrete Co. ..... 98A
Purcell, Lee T. ..... 113A

R

Rensselaer Valve Co. ..... 23A
Riddick, Thomas M. ..... 113A
Robert and Company Associates ..... 113A
*Robert Filter Co. ..... 104A

S

*Simplex Valve & Meter Co. ..... 107A
Sirrine Company, J. E. ..... 113A
Smith & Associates, Benjamin L. ..... 113A
*Smith Mfg. Co., A. P. ..... 87A
Smith Co., S. Morgan ..... 30A
*Smith & Loveless, Inc. ..... 93A
Standard Dry Wall Products Co. ..... 109A
Stanley Engineering Company ..... 113A
Stilson & Associates, Alden E. ..... 113A

T

Taylor Co. W. A. ..... 104A
Tennessee Corp. ..... 108A

U

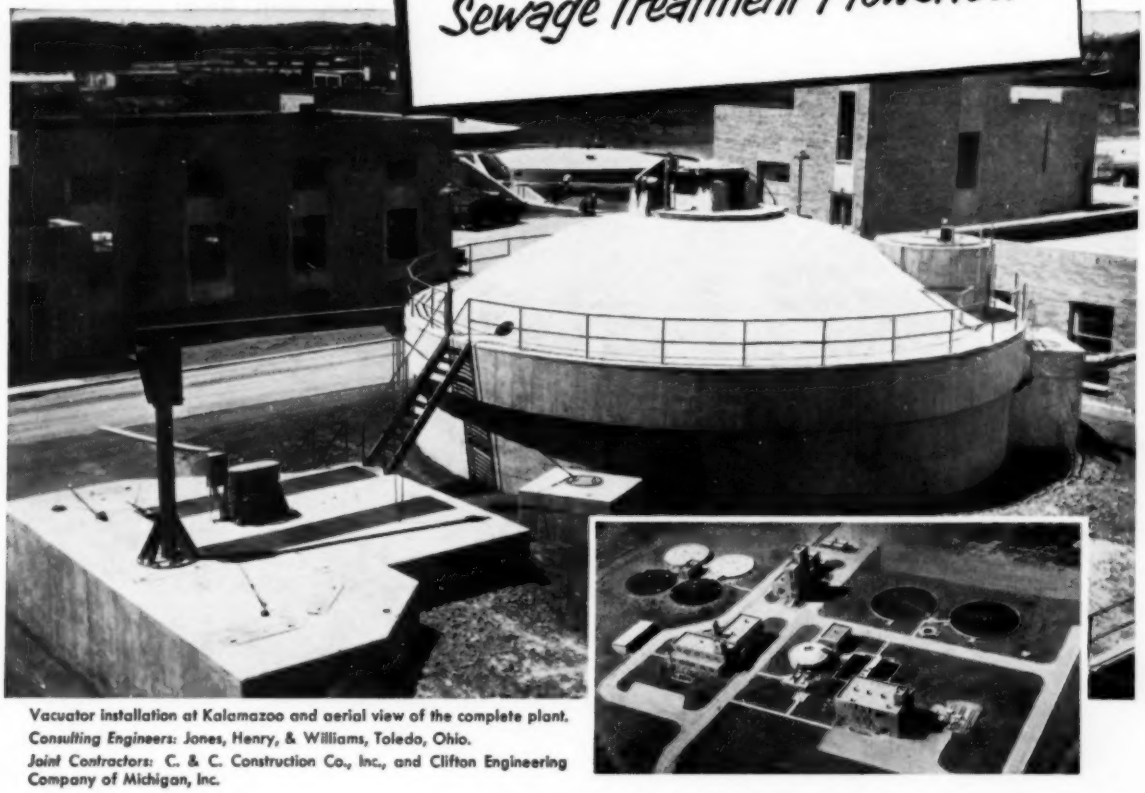
Uhlmann & Associates ..... 113A
*U. S. Pipe & Foundry Co. ..... 7A
U. S. Rubber ..... 83A

W

Wertz Engineering Co., Inc. ..... 113A
*Western Machy. Co. ..... 8A
Weston & Sampson ..... 113A
Whitman & Howard ..... 113A
Whitman, Requardt & Associates ..... 113A
W K M Mfg. Co. ..... Inside Front Cover
Wood Co., R. D. ..... 96A-97A
Woodward Iron Co. ..... 32A
*Worthington Corp. ..... 6A


*Advertisers represented in the 1956 Reference and Data Issue with Catalog specifications copy. Please refer to that issue for additional information concerning their products or equipment.

# There's a D-O UNIT for Practically Every Step in Every Sewage Treatment Flowsheet



Vacuator installation at Kalamazoo and aerial view of the complete plant.
*Consulting Engineers:* Jones, Henry, & Williams, Toledo, Ohio.
*Joint Contractors:* C. & C. Construction Co., Inc., and Clifton Engineering Company of Michigan, Inc.

## KALAMAZOO
**MICHIGAN**
*... uses a*
**DORRCO VACUATOR**
*for Primary Treatment ... and Chemical Precipitation to meet the seasonal fluctuations of the Kalamazoo River*

The 45′ dia. Dorrco Vacuator at the new sewage treatment plant at Kalamazoo is the first major unit of its type in that area. This unique plant flowsheet combines primary treatment with separate sludge digestion . . . with special provisions for chemical precipitation of the Vacuator effluent when a greater degree of treatment is desired.

Other D-O equipment at Kalamazoo includes two Dorrco Flocculator units in basins 54′ x 27′, two 85′ dia. Clarifiers, and two 70′ Dorr Multdigestion Systems.

If you would like more information on the complete line of Dorr-Oliver sewage treatment equipment write to Dorr-Oliver Incorporated, Stamford, Connecticut, for Bulletin No. 6041.

Flocculator, Vacuator, T. M. Reg. U. S. Patent Off.

DORR-OLIVER
INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
STAMFORD • CONNECTICUT • U.S.A.

# *The percentages are right with*

# INFILCO *High-Rate* SEWAGE TREATMENT

**100%.. ..Faster**
**50%.. ..Less Space**
**90-95%.. ..B.O.D. Removal**

**INFILCO's** improved activated-sludge equipment for *high-rate* sewage treatment is the answer to problems of maximum volume from minimum space—highest efficiency at lowest cost.

Complete treatment requires only five to six hours as compared to 10 to 12 hours in conventional plants. Area required is scarcely half as much. Expenses for property, construction, and operation are substantially reduced. And all this without sacrifice in efficiency. Here are typical operating figures from the installation in Collinsville, Okla.—

**EFFICIENCY**

| Date | Ave. Flow MGD | Average B.O.D. Raw Sewage | Average B.O.D. Final Effluent | Average B.O.D. % Removal | Suspended Solids Raw Sewage | Suspended Solids Final Effluent | Suspended Solids % Removal |
|---|---|---|---|---|---|---|---|
| 1/14-2/3, '55 | .069 | 287 | 21 | 92.7 | 335 | 22 | 96.5 |

These figures indicate what can be accomplished in treatment of sewage for institutions or small communities. If you have such a problem, consult INFILCO, because

**INFILCO KNOWS HOW** to help you solve it.

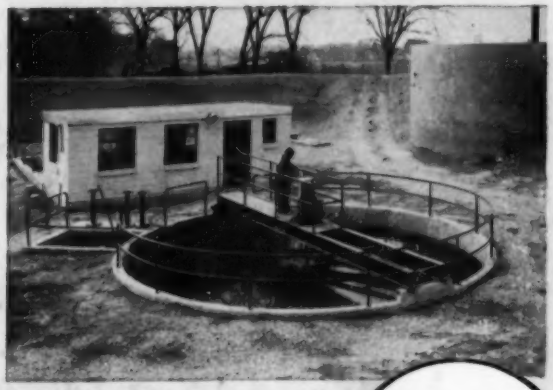
Over 60 years of experience and the most complete and advanced line of equipment are available to you. Write today for full information on the interesting Collinsville installation and Bulletin No. 6550 -WS-26.

Inquiries are also invited on all other water and waste treating problems including coagulation, precipitation, sedimentation, filtration, flotation, aeration, ion exchange and biological processes.

INFILCO

**INFILCO INC.**
**General Offices**
**Tucson, Arizona**
*The ONE company offering equipment for ALL types of water and waste treatment.*
FIELD OFFICES THROUGHOUT THE UNITED STATES AND IN FOREIGN COUNTRIES

9626

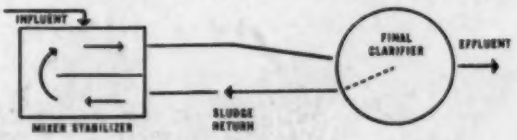


**BIOSORPTION®** activated-sludge plant for treatment of sewage at Collinsville, Okla.

*Consulting Engineers:* ***WOOD & CRAIG*** *Tulsa, Okla.*

**COLAFLEX®** diffuser

**FLOW DIAGRAM: DESIGN AVERAGE FLOW 0.21 M.G.D.**




48 **COLAFLEX®** diffusers in mixer-stabilizer